WORK

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FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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WORK WORLD.

THE addition of only 0·08 oz. of aluminium to a ton of zinc makes a galvanising metal of permanently brilliant and very adhesive character.

* *

A leather belt, without cross joints, to transmit 500 indicated horse-power, at a Rouen cotton mill, has been manufactured. It is of double thickness, 115 ft. long and 58 in. wide.

* *

The Mannesmaner process rails are tubular. Before the rail is quite finished the interior is filled with sand or any silicious powder. In the final passage through the rolls the heat and pressure applied forms the rail into a solid block of silica.

* *

A new counting machine has been erected at the Mint for "telling" bronze coin. This machine has four distinct sets of counting apparatus, each of which can be worked independently of the others. When all four are in full work upwards of 3,000 pence can be counted per minute.

* *

An automatic regulator for electrical pumps is made by connecting a ball-float in the tank with a switch in the circuit of the motor. As the ball rises it opens the switch and stops the pump, and as the water is drawn off the descending ball closes the switch and starts the pump again.

* *

The Gwynfynydd is a veritable gold mine. The diggers have struck a vein of gold-bearing quartz reported to be 4 ft. thick. Assayed specimens show a yield of 12 oz. per ton. The company started in December last, and in six months distributed £6,000, a return of 1,200 per cent. Who is in this?

* *

"The lightning was incessant," is a very common and inaccurate expression. The greatest frequency of lightning flashes ever observed in England was during the storm of June 6, 1889, when during the two hours ending 11.10 p.m. 1,244 distinct flashes of lightning occurred.

The newest addition to the first-class battle-ship of the British Navy will measure —length, 385 ft.; beam, 75 ft.; with a displacement of 14,180 tons. The estimated speed will be 17·5 knots per hour. She will be the heaviest vessel so far launched—her weight, at present, on the stocks, being not far short of 7,500 tons.

* *

On the Albany U.S.A. Railway forty-two heavy electric cars have been fitted with roller bearings. The rollers are three series of steel tubes side by side. The two outer series overlap: central and steel rods passed through all keep them in position. The central tubes are twice the length of the outside ones. Results with these roller bearings are very satisfactory.

* *

China has been noted for centuries for the purity of its lead, and that used for lining tea-chests is considered the finest of its kind. In making the sheets a large brick is covered with paper, the molten lead poured on it, and another brick laid on the top to flatten it out. The sheets are soldered together to the size of the interior of the tea-chest. This lead is used for the best kinds of solder.

* *

Cut flowers may be artificially coloured by placing them in solutions of aniline and other dyes. Aniline scarlet has a very rapid action in colouring flowers pink and scarlet. Indigo carmine produces beautiful blue tints; the two combined produce different shades of purple, and green is obtained by using blue dye with yellow. Narcissi are changed from white to scarlet in twelve hours; lilies of the valley are beautifully tinted with pink or blue in six hours.

* *

Aluminium plating for six-ton cast-iron columns is an American recourse. The castings are first soaked for a day in caustic soda to remove grease, then for another day in acid pickle to remove scale. They are then cleaned with steel brushes, and a heavy coating of copper applied, upon which the aluminium is deposited. There are about 100,000 square feet of iron to be plated, which will take about forty-two tons of metal. The plating is about $\frac{1}{16}$th of an inch thick.

A new hand camera for the use of amateurs who do not care to purchase a more expensive instrument is made for three sizes of negatives—A, $2\frac{3}{4}$ in. by $3\frac{1}{4}$ in.; B, $3\frac{1}{2}$ in. by 4 in.; C, 4 in. by 5 in. The cheaper forms have a single lens, and the more expensive ones a double lens; the negatives are taken on gelatine, which is fixed on a revolving spool containing material for twenty-four exposures. They can be fitted with a patent automatic locking and registering device, which prevents overwinding the film, and records the number of exposures made; they can also be fitted with revolving stops, adjustable speed to shutter, view finder, and focussing lever and index. The cheaper forms have fixed stop, and require no focussing.

* *

The "Graphonome" is a device consisting of four laths, loosely jointed at the angles so as to resemble a frame which has lost its slate and has worked loose. To the middle of one of the sides is fixed a fifth arm, susceptible of folding flat with the side or of turning up against it at right angles with a stop. A slotted protractor, graduated to 120°, is also fitted to one of the sides near its joint, a threaded pin in an adjacent side moving in the slot, and by means of its milled nut clamping with the sides at any angle (up to 120°) to which they may be set. An inside acute angle is measured by simply applying to it that part of the instrument which is opposite the protractor, when the angle may be read off from the scale by means of an index on the pin, which moves in the slot; and the angle may also be marked off directly on paper by the sides of the instrument. For measuring an inside obtuse angle, one side of the instrument is applied to one side of the angle, and the fifth arm is turned up perpendicularly to the other side of the instrument, the outer end of this fifth arm being formed in such a manner as to make with its side an angle of 45°. This latter angle, added to that read off from the protractor, will give the obtuse angle measured. An outside angle, whether acute or obtuse, is measured and may be marked off directly by folding together the two arms on which the protractor works over the two remaining arms, and applying the instrument to the angle.

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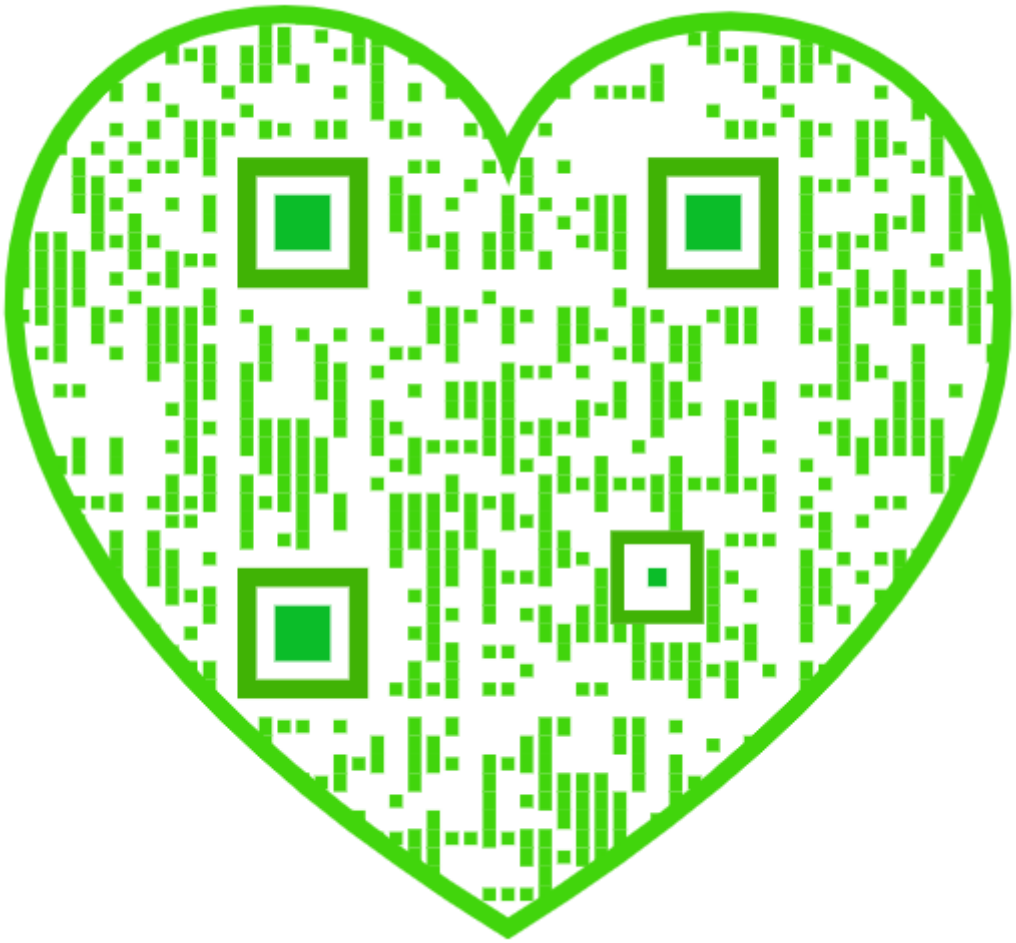

HOW TO MAKE A MAHOGANY MAGIC LANTERN.

BY O. BECKERLEGGE.

The Optical Arrangement.—For the construction of this we shall require sheet brass 12 in. or more square and $\frac{1}{8}$ in. thick, also sundry pieces of tubing. We will take for granted, for the present, that our condenser cell is made—and here I might say that for very little more than the price of the lenses they can be purchased ready mounted—and that its diameter outside is $4\frac{1}{8}$ in. Procure a piece of tubing, 1 in. long, and of a size to take the cell spring tight. If a piece cannot be procured the right size, then put a saw-cut in a piece a little too large and resolder it; by this means the proper size may be secured. Put it in a lathe, and cut the ends true. Out of the sheet brass cut a piece 6 in. each way. I have found in practice, without special appliances, that the quickest way to cut sheet brass this thickness is to use a fret-saw, and I have only a hand-saw, not treadle. I use a fairly strong blade, and allow it to cool occasionally, which it does in a few seconds. Choose the fairest side of the brass, and hammer it out as true as possible; remove bruises, and with emery bring up the face fair. On the inside strike a circle a shade larger than the diameter of the ring just made; this is to enable us to adjust the ring to the centre of the plate. They must now be firmly soldered together. A circle may be scribed on the front of the plate $\frac{1}{4}$ in. less than the cell; and if we are wishful to economise our metal, this may be cut out with the fret-saw. Turn down a piece of wood on which to chuck the ring, and finish off the edge of the opening, which must be left a little smaller than the ring, so as to form a flange to stop the condenser cell. At the four corners (see Fig. 4, No. 174, p. 277), holes must be bored about $\frac{3}{16}$ in., with the back countersunk; into these, rods must be riveted and soldered. Before doing so, the other end must have a thread cut on it to take the boss C. Four pieces of tube, of a size to go over the rods, and 1 in. long, must be slipped on them.

A second plate of brass must be prepared in the same way as the other, with a 4 in. opening, and four holes large enough to admit the tubes on the pillars; the sides must be curved forwards as E, Fig. 2. Four spiral springs must now be placed on the pillars, as shown. A third plate must now be prepared as the first, with a central opening 4 in. diameter and four holes at the corner coincident with, and the same size of, those in the first plate; this will rest on the four tubes, and be retained eventually in its place by the bosses. The spiral springs acting against this plate will naturally force the middle plate against the slide carrier, and retain it in its position. We must now either get 8 in. of tubing 4 in. diameter, or else 4 in. of 4 in. diameter and four of a size that will pass over it spring-tight. If the latter plan is not easy to adopt, then we must proceed as follows: Cut the tube into pieces of four inches. Make a saw-cut in one piece, and with a file take off sufficient to allow its diameter to be reduced that it will pass tightly into the other half, and solder the joint. Put it on a mandril, and turn the ends true. Let the circular opening in the plate be sufficiently large to fit the tube tightly.

If the ends of the tube are perpendicular to its axis, and the plate perfectly flat, there will be no difficulty in setting the tube perpendicular to the plate. When this is so, then solder them together.

Procure a piece of brass $\frac{1}{4}$ in. thick and $4\frac{1}{4}$ in. diameter, to make a ring, as K, Fig. 1. If a piece of brass that thickness is not to be had, then two rings of $\frac{1}{8}$ in. sheet can be soldered together. This must be soldered to the second piece of tubing. Put it in the lathe and turn down, milling the outer edge, and chasing the opening to receive the pinion tube, H, one end of which must be chased to screw into K, and the other must have a ring soldered on and milled. A tube, I, to fit without shake, must be procured to slide into H, ; this must be supplied with a rack. The rack and pinion can be purchased; and I should recommend anyone to do so in preference to making. Racks are made in large quantities at a time in a lathe, and can be purchased for a few pence each; but to make one would require some considerable time. When procured, two or three teeth must be filed away at each end, and a hole must ultimately be drilled in the projecting pieces to take a screw.

Draw a line on the tube coincident with its axis, and on each side one, the outer lines being equal to the width of the rack. Measure and mark off the length of the rack. Along the central line drill a series of holes, and cut away by this means as much of the metal as possible; then file away the remainder up to the lines.

Place the rack in position, and see that the top of the teeth are exactly level with the outside of the tube; with a touch of solder tack it in its place, and drill a hole at each end of the opening into the tail-pieces of the rack, and secure with screws. In H a square hole must be cut, to receive the pinion. With a rat-tailed file as much of the tube must be taken away on each side as will allow the pinion to engage firmly in the rack. A cover must be made as Fig. 8, A, B, C, and fixed with four screws. The outer end of I must be finished off with a milled edge, as shown, and the inner end must receive a thread to take the cell with the front lenses. A stop, J, must be placed as shown.

We have gone on the assumption that the condensers have been purchased mounted, but it is possible that some would prefer to mount their own. Each lens must be mounted in a separate cell, and screwed into a tube $\frac{1}{4}$ in. longer than the combined thickness of the two lenses, so that they do not touch each other. When the cell is made either out of a casting or built up, a thread must be chased on it, and the inner edge turned down thin. Fix the cell in a chuck, and place the lens in its place; get someone to press a finger against the lens to retain it in its place, and with a burnisher turn down the thin edge of the brass over the lens. Care must be taken that it has a slight shake, else, if perfectly rigid, the expansion of the glass may result in a fracture.

One or two holes should be made in the tube for ventilation. Fig. 5, A, gives a section of the cell. In Fig. 5, B, I have shown a cell more simple in its construction. A cell is made in two pieces, to be screwed together as shown. The outer ends are turned out so as to form a bed to receive the lens; the edge is then burnished over, as in the other case.

Front Lens.—These may be purchased mounted. If it is intended to mount the lens, then proceed as follows: Procure a piece of tube 1 in. long: on one end cut a thread to screw into I (Fig. 1). On the inside turn down a bed to receive the lens, and chase an inside thread to receive a screwed ring to keep it in its place. A general working idea may be gathered from the condenser cell.

Two or three front lenses may be provided for exhibiting at various distances—say, for 20 ft. away a 6 in. front lens may be used; for 40 ft. an 8 in. In this case the tube G (Fig. 1) must be drawn out. If a greater distance is required, then a front lens of longer focus must be used, and the length of G must be increased by an additional tube; but in this case the limelight must be used. These separate fronts are made with male and female screws, so that two can be used at a time. This will lessen the distance needed from the screen. Fig. 7, A and B, give an idea of the top. The chimney is placed on the collar at the top, and should be, say, 14 in. high. The top must be arched over, to prevent the escape of light.

Illumination.—I have been writing on the assumption that a lamp is to be used. About the construction of this I have nothing to say; I freely admit it is beyond my ability. The construction of a safe lamp, to give a good light, is not work for an inexperienced worker. I should, therefore, advise one to be purchased—a four-wick—which may be done for about 16s.

I trust that these hints will enable many to construct a handsome and efficient lantern, which certainly could not be purchased for two or three times the sum it will cost in its construction. If the plate, D (Fig. 1), instead of being let into the body, is joined by two hinges at the top, it would admit of its being drawn forward at the bottom so as to raise the disc higher on the screen, if needed. This would render it unnecessary to pack up the lantern, as is often the case, to bring the disc in the middle of the screen.

The lantern is now finished, and must, with all tubing, be blackened inside, whilst the body should be polished and the brass-work lacquered.

BENT IRON WORK, AND HOW TO DO IT.

BY J. H.

Letter Rack and Brackets.

Rack for Newspapers or Letters — Wall Bracket—Back—Supporting Scroll Work—Brackets for Suspension—Suspension Bracket—Another Form of Ditto.

Rack.—Fig. 33 illustrates a rack suitable for holding newspapers or letters. For the first, it may be made from 12 in. to 14 in. long; for the second, from 6 in. to 8 in. long. It is suspended from the wall by the eye, A. If the rack is of small size for letters, the framing, B, may be made of the thin strips, of $\frac{1}{4}$ in. or $\frac{5}{16}$ in. in width. If it is of the large size, the framing should be of stout iron, $\frac{1}{16}$ in. thick by $\frac{3}{8}$ in. wide. The framing, B, consists of a small rectangle, turned round at a right angle at A, shown also in the side view, Fig. 34, A. The rectangle is to be formed in one of the ways mentioned in connection with the screen (see No. 166, p. 153). The neater way in this instance, the frame being so small, is to make a scarfed and brazed joint. If the amateur cannot manage that, then make a plain lapped and riveted joint. Be careful to have the iron straightened and the frame free from winding. The cross-bars, C, C, had better be inserted by bending their ends round (Fig. 34, B), and riveting or clamping them to B.

The scroll work is very simple. The

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S curves form a panelling. They are secured with clips at each point of contact, both with each other and with the frames. The clips are shown in the figure. The width of the iron in the scrolls should be the same as that in the framing. The eye, A, at the top is formed of thin iron, bent underneath, and soldered to the top bar of the frame, B.

Wall Bracket.—Fig. 35 shows a handy wall bracket, useful for any casual purpose, as to put by the bedside or writing-table, or in a passage for a candlestick, books, letters, cards, etc. Excepting the back, A, it is made entirely of thin bent iron. It comprises essentially the top, B, the back, C, and the central supporting bracket, D. Taking the parts in detail, the top is formed of a back strip, A, of thin iron, hammered round, as shown in detail at Fig. 36, to form a narrow bottom flange, A. The width, A, of the flange is equal to the width of the strips which are intended to be used on the bracket—say $\frac{3}{8}$ in. Two slot holes, *b*, *b*, are made by drilling, to hang the bracket up by. A strip, *c*, of thin or of stout iron—preferably of the latter—is bent into a semicircle, and attached to the back strip, A, in the manner shown at Fig. 36, by turning the ends of *c* inwards, and soldering them to A. The space included between A and *c* is filled-in with scroll work of thin iron, $\frac{3}{8}$ in. or $\frac{5}{16}$ in. wide. There are four similar sets of scrolls, and at all points of contact, both of the scrolls with each other and with the outer curve, *c*, clips should be made use of. They are shown in the figure.

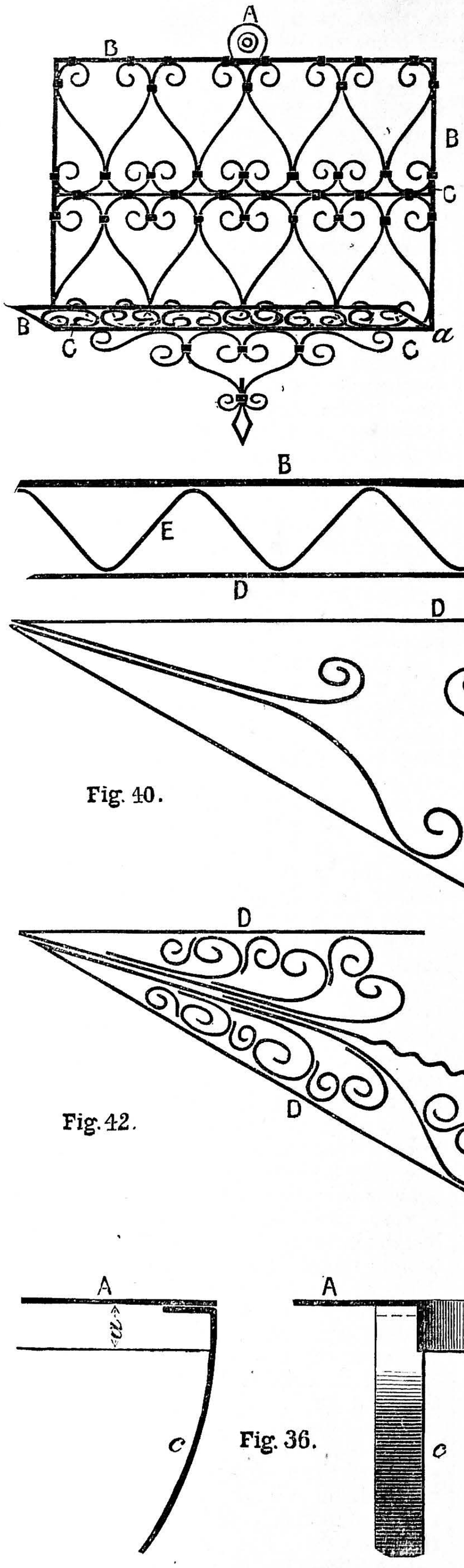

Fig. 33

Fig. 41.

Fig. 40.

Fig. 42.

Fig. 36.

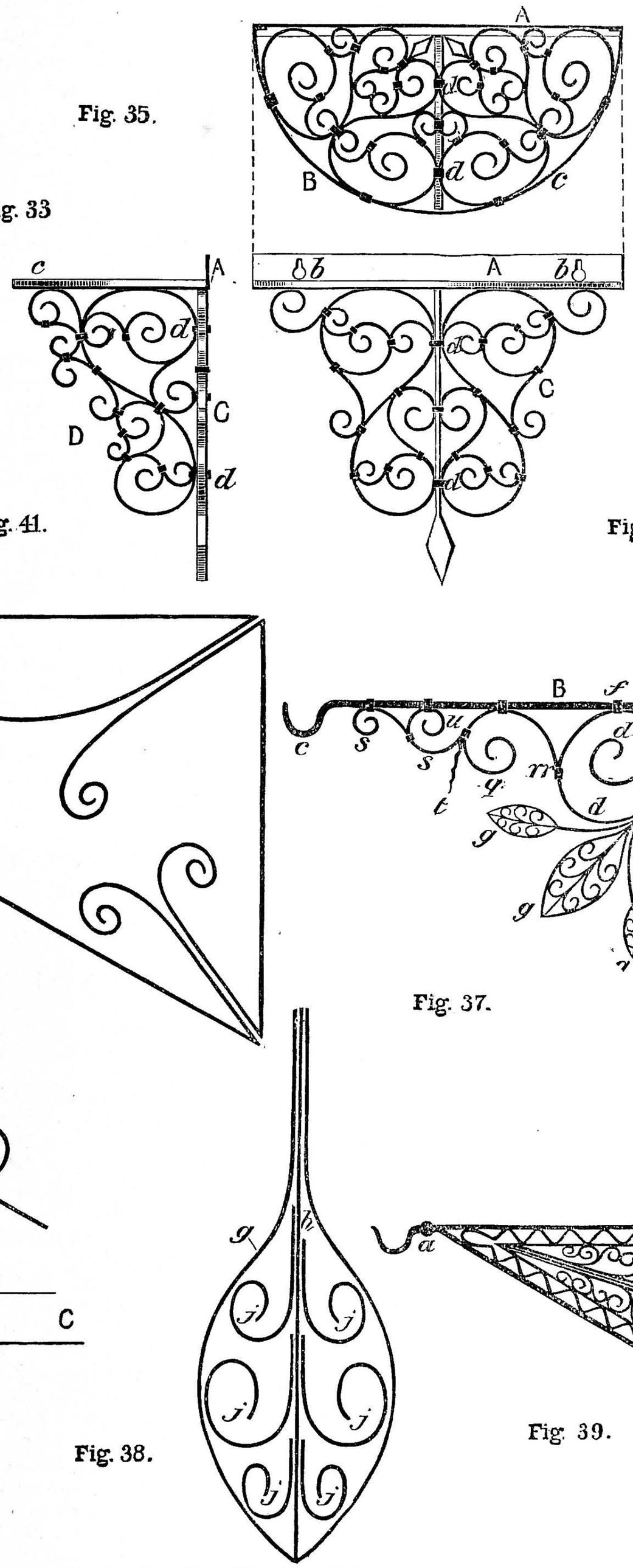

Fig. 35.

Fig. 38.

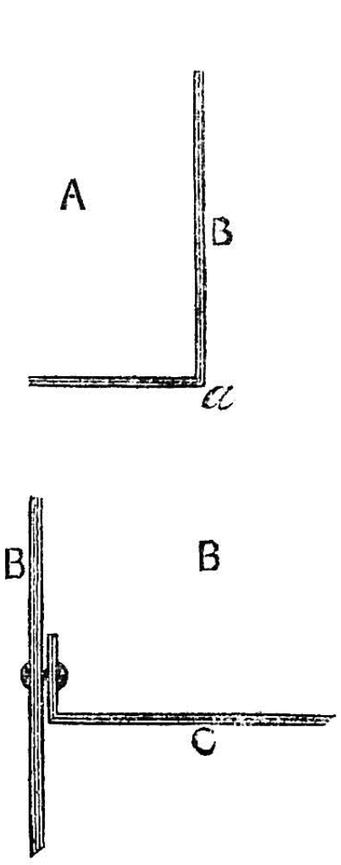

Fig. 34.

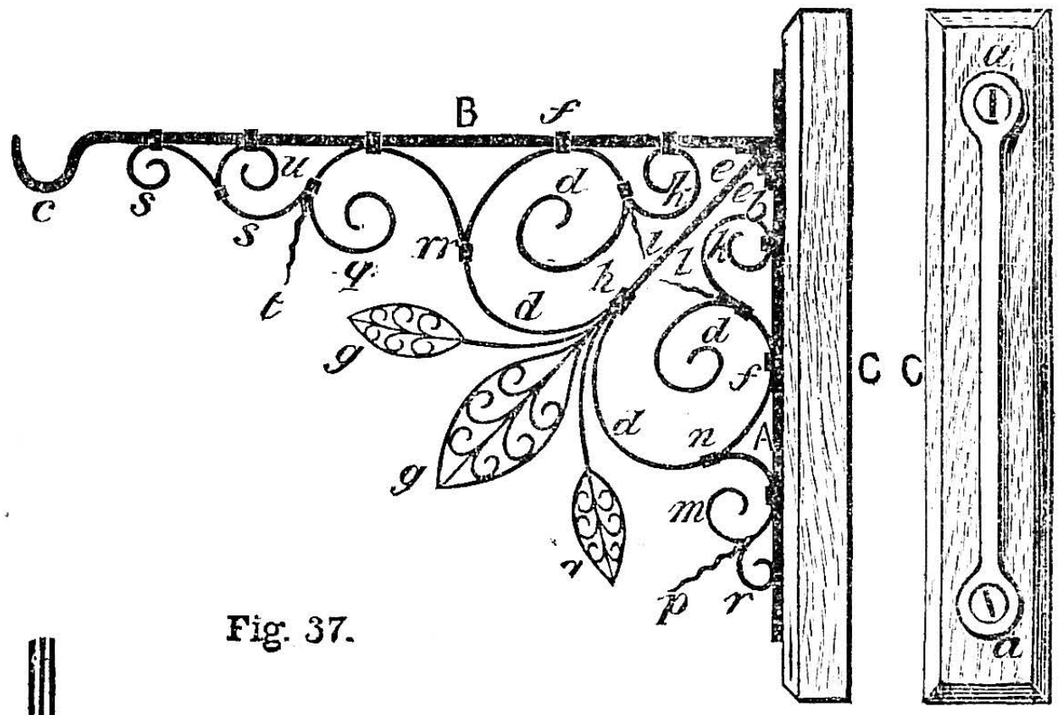

Fig. 37.

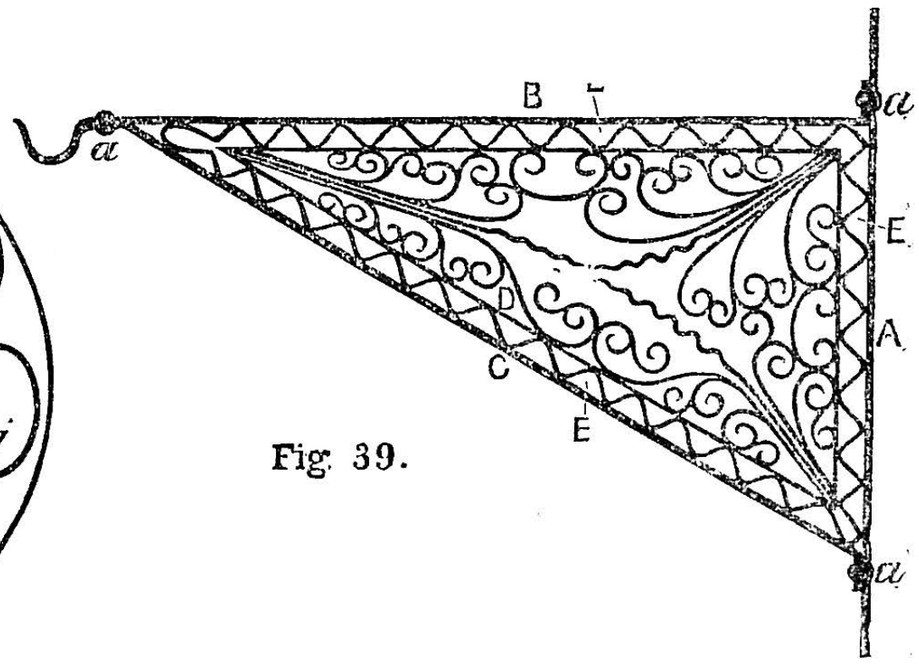

Fig. 39.

Bent Iron Work. Fig. 33.—Newspaper or Letter Rack. Fig. 34.—Details. Fig. 35.—Wall Bracket: A B, Plan; C, Front Elevation, with Bracket D removed; D, Side View. Fig. 36.—Detail of Fastening. Fig. 37.—Wall Bracket. Fig. 38.—Detail of Leaf. Fig. 39.—Wall Bracket. Fig. 40.—Detail of Inner Frame. Fig. 41.—Detail of Border: Parts separated. Fig. 42.—Detail of Scrolls: Parts separated.

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Back.—The back, C, of the bracket consists of duplicated scroll work, with a central arrow point or finial. The curves are united for the most part with clips, but at the top, where they come in contact with the narrow flange of the back, A, clips cannot be used, because the back is of solid sheet. Solder will be the most suitable means of union here.

Supporting Scroll Work.—The supporting bracket, D, is bound with clips to the back and to the top curves at the points *d*, *d*. These clips are all shown in the figure, but necessarily exaggerated in the proportion of thickness. In the actual work, if done neatly, the clips add very little to the thickness of the parts in contact.

Brackets for Suspension.—I want now to say a little about brackets of a different type—those, namely, which are used for the support of lamps and lanterns, of bowls and vases, and other articles of use and ornament. These afford a wide scope for artistic design of a more or less ornate character. I shall give examples of brackets of various types in future articles, in connection with the work suspended from them. In the present article I will describe two examples which will not occur in future designs.

Suspension Bracket.—Fig. 37 shows one of the simplest that can possibly be made. It is also a form that is only suitable for sustaining very light objects. The back, A, and top bar, B, are made of stout iron rod, of from $\frac{1}{4}$ in. to $\frac{3}{8}$ in. square section, according to the size of the bracket. The back bar is upset and flattened at the ends, as shown at *a*, *a*, and holes are drilled and countersunk to screw the bracket to the wall by. The iron bar may go directly against the wall, or a wood backing, C, may be interposed as shown.

The top bar, B, is fastened to A by riveting. The end is turned down at *b* for the purpose. The opposite end, *c*, is formed into a hook, from which the bowl, lamp, or lantern, as the case may be, is suspended.

The scroll work in the example shown is simple. It is of thin iron, $\frac{3}{8}$ in. or $\frac{1}{4}$ in. wide, to correspond with the width of the bars A and B. The main scrolls, *d*, *d*, are exact duplicates of each other, their stalks coming out at an angle of 45° with A and B. The stalks are turned sharp round at *e*, *e*, and are attached to B and its turned-down end *b* with clips or with solder. Clips secure the scrolls to the main bars at *f*, *f*.

Between the bifurcation of *d*, *d*, the three conventional leaves, *g*, *g*, *g*, branch out. Their stalks are embraced between *d*, *d*, and the whole secured with a stout clip, or a couple of stout clips, at *h*. The leaves are made as shown in the enlarged view (Fig. 38). The margin is formed of a strip of bent iron, *g*, bent round to an ovate form, and upon itself, to pass between *d*, *d*. A central strip of thin iron, *h*, forms a midrib, and passes down between the parallel portion of *g*, where it is held with the clip *h*, in Fig. 37. Six or more small scrolls, *j*, are bent to occupy the space enclosed by *g*, and are secured with solder or with clips to *h*. If the leaf is large, they should also be clipped or soldered at their points of contact with *g*.

The smaller curves are: *k*, *k*, fastened with clips to *d*, *d*, the tendrils, *l*, *l*, being pinched between them. Clips also secure them to A and B; the curve *m* is fastened at *n* to *d*, and also to A; the curve *r* is fastened to A, and also to *m*, embracing also the tendril *p*; *q* is clipped at *r r*, and to the bar B; *s* is clipped to *q*, with the tendril *t* between, and also to B; *u* is fastened to *s*, and also to B. This is an easily-made bracket, but only moderately strong.

Suspension Bracket.—Fig. 39 is a much stronger bracket, and also rather elaborate in design. The main framing consists of the back bar, A, the top, B, and diagonal, C. The three are united with rivets at *a*, *a*, *a*, through the ends set off at those positions. This, therefore, makes a strong frame, the diagonal, C, preventing the top bar, B, from becoming bent downwards.

There is also an inner frame, D, carried equi-distantly from the outer one all round. The frame is made in three parts (see Fig. 40), corresponding with the three sides, and one piece of the scroll work. The advantage of making it in this way is that there is no trouble in inserting the scrolls in the corners, as there would be if the frame were made in one, and the scrolls inserted independently of the frames.

The inner and outer frames are united with the waved border, E, a portion of which is shown enlarged in Fig. 41. It consists simply of thin iron strip, of from $\frac{3}{8}$ in to $\frac{1}{4}$ in. wide—that is, of the same width as the frames, bent backwards and forwards with the pliers, and fitted between, and clipped to both frames.

The filling-in of the smaller scroll work is a matter of detail, which can be traced out from the drawing. In Fig. 42 I have shown the series of scroll work nearest the end of suspension, with the parts separated in readiness for clamping together. All the separate portions, therefore, are clamped to the scrolls, which form the continuation of the framing, D, shown in Fig. 40. Also, wherever these come in contact with the straight portions of D, clips will be employed.

WATCH AND CLOCK CLEANING AND REPAIRING.

BY A PRACTICAL WATCHMAKER

It is intended that this paper shall be the first of a series dealing with the cleaning and repairing of watches and clocks, and the aim throughout will be to make them as plain as possible.

This paper will be devoted to generalities, so to speak, and will not treat upon any special part of either a watch or a clock, but in it a few of the necessary tools and appliances will be brought before readers, and their uses explained. Following the order set forth in the title, those relating to *watch-work* will be first considered.

The first requisite is a bench. For the amateur who only occasionally goes in for horological work, almost any existing bench (except, perhaps, a carpenter's bench) will answer the purpose. The one thing requisite is that it must be quite clean, and the surface smooth. To obtain this, any existing cracks or knot-holes must be carefully filled up with sealing-wax. It is, of course, taken for granted that any respectable work-bench is surrounded by a ledge of some sort, and also stands in a good position as regards *light*.

Those who desire to make a bench especially for watch-work are strongly advised to make it of 1 in. mahogany board. For a plain bench, or *board*, as watchmakers generally call it, upon which no mandrel or lathe is to be mounted, a good size is about 3 ft. long by 18 in. wide, with a 3 in. ledge round ends and back, and a $\frac{1}{2}$ in. ledge along the front. It should be arranged at such a height that the workman can either sit or stand to it comfortably. In such small and tiring work, a change of position is sometimes very welcome. If the reader is in possession of a small lathe or watchmaker's mandrel, by all means mount one or both upon the board, which in that case must be made longer in proportion. Boxes similar to those used to cover treadle sewing-machines should cover these when not in use.

Next to the bench, the vice is the most essential tool in this, as in almost all other work. The vice should shut close, have hard steel jaws, and be provided with centre holes for drilling, etc. (dots on the ends of the jaws, for a right-handed workman, on the left of the vice). I hope I shall not be giving an undue advertisement when I say that undoubtedly the best vice made for watchwork is Boley's parallel vice, shown in Fig. 1. The jaws always close flat, however wide they are opened, and are of hardened steel and interchangeable; new ones can be fitted in case of damage. These vices can be obtained at any watchmakers' tool-shop in Clerkenwell, such as Hunt & Son, Grimshaw & Baxter, and others. This applies to any tools and materials mentioned in the course of these papers.

It will be unnecessary to figure the several pairs of pliers and cutting nippers used, as their form is well-known to anyone. It will suffice to say that a couple of pairs of each, the smallest made, and a size larger, are necessary.

A useful tool is a pair of "sliding tongs" (Fig. 2). These are used to hold any small article whilst being filed or otherwise operated upon, and are, in fact, a kind of hand vice. The slide instantly grips, and as easily releases. The "pin vice" (Fig. 3), as its name implies, is for holding pins whilst they are being filed down, and also for a variety of other purposes. The manner of using this tool and others will be explained farther on. I may mention that that form of pin vice which has a through hole right down the centre is the handiest. Sundry small screw-drivers, the blades of which vary from $\frac{1}{32}$ in. in width to $\frac{1}{16}$ in., are necessary. These are readily made from pinion wire, filed to shape, and the blade hardened. On the tops (they should be about 3 in. to 4 in. long) there should be a flat button riveted, to rest on the finger or in the palm of the hand. Fig. 4 shows a screw-driver made as described. A pair of fine light hollow tweezers, and a somewhat heavier pair, should also be upon the board.

Very good watchmaker's drills can be bought in boxes of 126, assorted, with stocks to hold them, for about 4s. 6d.; but later on, when we come to practical work, the way to make them will be explained, and it may here be said that home-made drills are far and away superior to these shop drills.

Next to drilling holes, tools to enlarge them to any required size must be considered. For this purpose "broaches" are used, small five-sided rimers—or reamers, as some call them—from the thickness of a hair up to about $\frac{1}{8}$ in. in diameter. These are slightly tapered, and follow each other in running sizes. Fig. 5 shows one.

For "tapping" holes—*i.e.*, cutting screw-threads in them—minute taps, similar to those used by engineers, are used. These are made by the workman from a purchased screw-plate, the method to be explained later.

We now come to files. Of these, there should be always upon the board a "pottance" file, a size and quality known in the trade, and a "pillar" file. These two files will do most of the plain pin filing, etc.,

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etc., required in ordinary jobbing. For special purposes, however, such as fitting hands, filing out holes, and a multitude of small operations, a set of smaller files is necessary. These should be square, triangular, round, flat, oval, knife edge, etc., etc. Some are known as "side files," "crossing files," "slitting files," etc. etc. Fig. 6 shows sections of some of these, those known by special names being so denoted. The *dark* lines represent the cutting sides.

Amongst odd tools which will be found very useful may be mentioned a pair of *brass-nosed pliers*. These are usually made from an old pair of ordinary pliers by filing away the faces and soldering flat pieces of brass in their place, and are used for handling articles of polished steel, which would be damaged by hard steel pliers. An ordinary oval tapered *burnisher*, about 4 in. long, set in a handle, is very useful. *Chamfering* tools, both round-faced and pointed, are required for dotting centres of holes to be drilled, taking burrs off edges of holes, countersinking holes, and other purposes. They are easily made from pinion wire, the same as the screw-drivers before mentioned. The pointed ones are sharpened down to a triangular point, having three cutting edges, and must be carefully hardened and sharpened upon the oil-stone. Fig. 7 shows one. The round ones must have semicircular cutting edges of various sizes.

An *oiler* is a very important tool, though very small and insignificant-looking. Fig. 8 shows one. It consists of a piece of, say, No. 60 steel, hammered flat at one end and filed up as shown. The other end is dipped warm into sealing-wax to distinguish it from an odd piece of steel. Its use is to apply oil to watch parts, drills, etc. etc.

A set of punches made of round steel, about ⅛ in. in thickness, must be provided. They are flat-faced, round, pointed, and various other shapes.

Speaking of punches naturally suggests the *hammer*. The watchmaker's hammer is not a very formidable affair. It weighs ½ oz., and the most gentle taps are sufficient for most purposes of watchmaking.

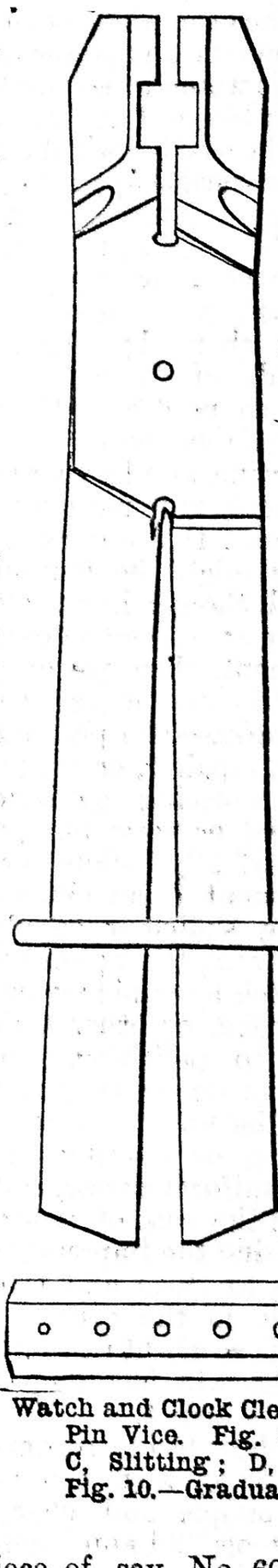
A *stake* to screw into the vice to hammer upon is merely a piece of hardened steel with a circular, flat, polished top. The bottom is squared to grip in vice (Fig. 9). Another kind of stake is also useful. This is provided with a row of graduated holes for punching and other purposes (Fig. 10).

One or two pieces of boxwood for filing upon, and a piece of cork, should be upon the board or within reach.

A bundle of the smallest sized "pegwood" for cleaning out pivot holes, and some "pith" for cleaning pivots are necessary. A benzine pot in which to dissolve off all grease and old oil from the parts should be provided. At material shops proper glass pots are sold having ground-in covers, which effectually prevent the benzine from evaporating; but the amateur may use a glass or china pot with an ordinary cover—say, a tooth-paste pot.

Last, but by no means least, we come to the "eye-glass." It is a great mistake to have a very powerful one in constant wear. A glass of 3½ in. or 4 in. focus is much to be preferred to one of 2 in. or 2½ in., such as are used by many workmen. The glass should have a "stop," which may be cut out of brown paper and fixed upon its surface, allowing only the central ½ in. or so to be used. The rays of light transmitted by the margin of the glass add nothing to the distinctness of vision, but, on the contrary, only confuse the eye by giving a glare of light in the wrong place. There is one other thing in connection with the eye-glass, and that is the method of holding it. The usual practice of holding it by means of the muscles of the eye is not calculated to improve the vision. Objects can be seen much more clearly and with greater comfort if the glass is held by a coil of wire thrown around the head. When held thus, it is pushed up upon the forehead when not in use, and is out of the way; at the same time, it is always ready to hand when required.

If, for the time, we leave turning altogether out of the question, these are the tools, etc., required for ordinary cleaning and putting in order of watches—that is to say, the above are absolutely necessary; and it may be added that the more tools a workman possesses the easier will be his work.



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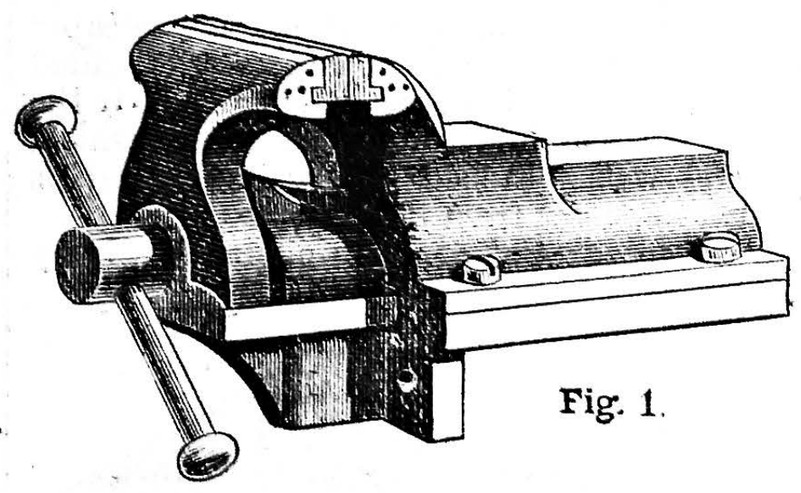

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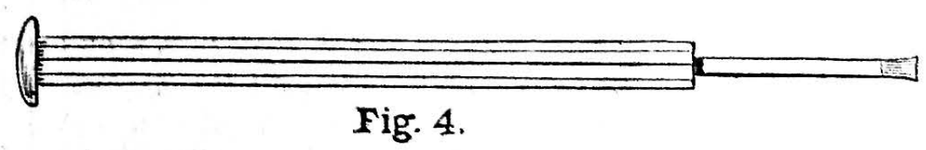

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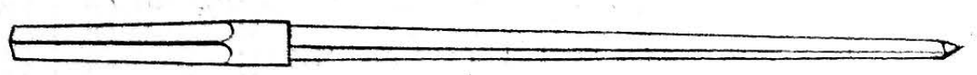

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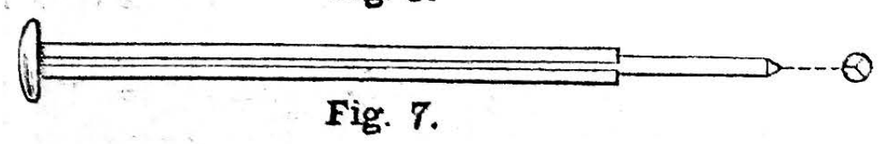

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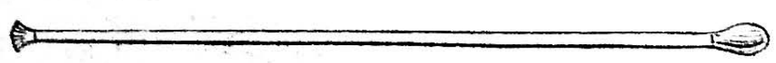

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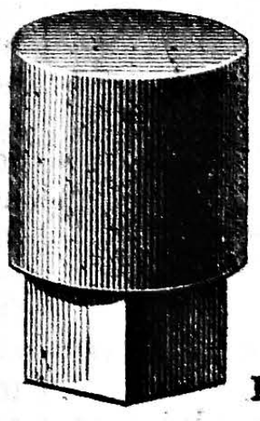

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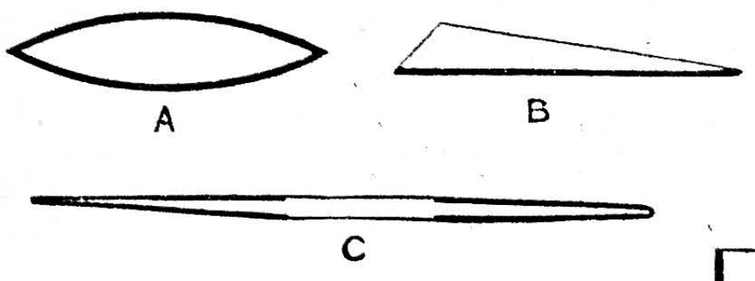

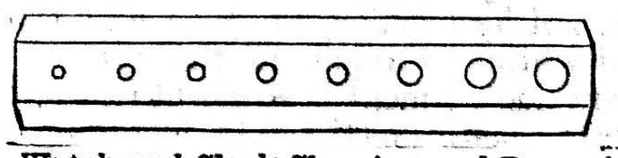

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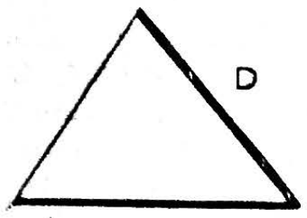

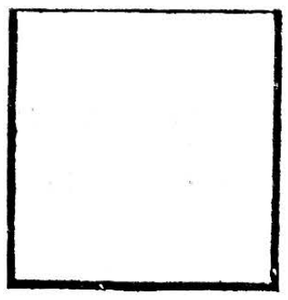

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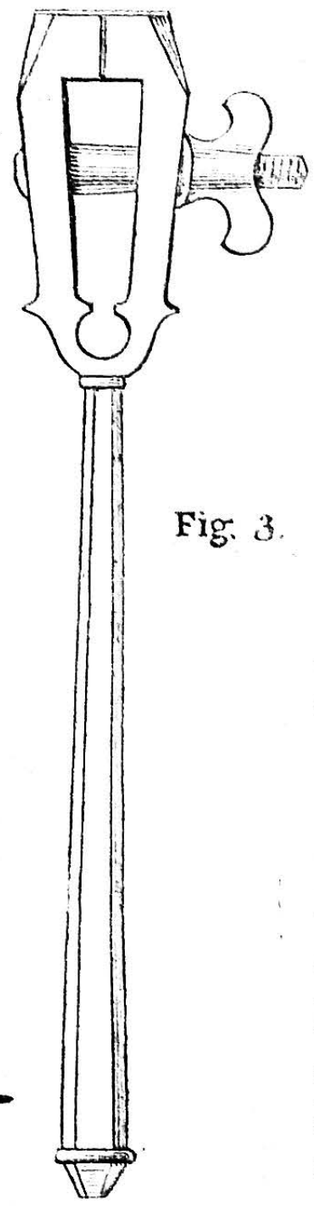

Fig. 3.

Watch and Clock Cleaning and Repairing. Fig. 1.—Boley's Parallel Vice. Fig. 2.—Sliding Tongs. Fig. 3.—Pin Vice. Fig. 4.—Screw-driver. Fig. 5.—"Broach." Fig. 6.—Files Sections—A, Crossing; B, Side; C, Slitting; D, Triangular; E, Square. Fig. 7.—Chamfering Tool. Fig. 8.—Oiler. Fig. 9.—Stake. Fig. 10.—Graduated Stake.

TIPS.

To convert common ink into copying ink, put in a spoonful of good sugar, stir it till dissolved, so as not to be thick, but sticky.

ANOTHER substitute for india-rubber is on the market. It consists of Manilla gum, tempered with benzine, containing two per cent. of Auvergne bitumen also mixed with benzine. These are thoroughly mixed, and five per cent. of resin oil added. The product is stated to be equal in elasticity, solidity, and durability to the best samples of rubber.

FOR elastic moulds the principal material used is glue or gelatine. Fish glue will answer as well as gelatine and it is much cheaper. To each pound of gelatine three-quarters of a pint of water and half an ounce of beeswax are added. The whole is dissolved by heat. The model must be carefully covered with sweet oil, and the composition poured upon it while warm, but not boiling.

To join marble or alabaster, mix half a pint of best vinegar with half a pint of skimmed milk. Draw the liquor from the curd which settles, mix the curd with five eggs, thoroughly sift fine powdered quicklime to form a paste: used in joints, it will resist water but not much heat. Many household articles might be repaired with it.

A RED cement for iron or stone is made of red lead and litharge in equal parts mixed with concentrated glycerine to the consistence of soft putty. When dry it is water- and fire-proof. There are many trades in which this cement would be found extremely useful.

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A RUSTIC GARDEN SEAT, WITH CANOPY.

BY ARTHUR YORKE.

REMARKS ON THE DESIGN — MATERIALS — CONSTRUCTION.

Remarks on the Design. — This design, sketched in perspective in Fig. 1, is for a fixed garden seat for two persons. There are certain situations in which such a seat —a something more important than the ordinary garden chair—would have an excellent effect: as, for instance, at the end of a long straight walk. Where shade is required, the back and canopy offer facilities for securing it, as they can be covered with climbers. Fig. 1 is not drawn to scale; the other diagrams are ¾ in. to the foot.

Materials.—The upright posts and all the more important pieces will best be formed of somewhat small larch stuff; the smaller straight sticks may be hazel, birch, or withy. The last named, stripped of its bark, and used in some parts only, will form a pretty contrast with the darker rods. In filling spaces in back and canopy, a few pieces of crooked stuff are used; these will probably be of apple-tree.

Construction.—The two posts, on which almost the entire weight is sustained (marked A in the several diagrams), should be let into the ground not less than 2 ft. They rise 5 ft. above the ground-line. They are set at a distance, measuring from centre to centre, of 4 ft. apart. The smaller posts (marked B), which support the seat, stand 17 in. in advance of those last named, and should be let into the earth 1 ft. The broad seat thus given is essential to comfort when the back of the chair is upright, as it must be in this instance.

It will be seen that two principal cross-pieces are nailed against the main posts. Of these, the lower one, which is of halved stuff, is 15 in. from the ground, and carries the back of the seat. The other is close to the top of the posts, and carries the back of the canopy. The canopy is chiefly supported on the three wall-plates (if I may so call them), C, C, C, in the Figs., which rest at one end on the heads of the posts, and towards the other on the struts, D, D, D (Fig. 3). Fig. 4 shows in plan the arrangement of the principal pieces forming the canopy: E E are the rafters of the gables, the lower ends of which rest on the wall-plates, and the upper against the pinnacle, F. The back rafters are marked G G, and these rest their lower ends on the cross-piece and their upper against the pinnacle. Fig 5 shows the filling-in of the two back panels of canopy; Fig. 6 that of the four side panels.

The filling-in of the back of the seat is so clearly shown in Fig. 2 that no explanation of it can be necessary.

In Fig. 7 the seat proper appears in plan. Its front and ends are of halved stuff, nailed to the posts. The spars forming the seat are placed with spaces between them, that they may not hold moisture; for the same reason, it is advised that they should be of peeled withy.

HOW TO IMPROVE THE KEYS OF MUSICAL INSTRUMENTS.

BY LIFEBOAT.

MATERIALS USED AS COVERINGS — CHANGING COLOUR—HOW TO DISTINGUISH—BLEACHING IVORY — REPAIRS — TO REMOVE THE KEYS FROM PIANOS, ORGANS, HARMONIUMS.

Materials used as Coverings.—Piano, organ, and harmonium keys, the part touched by the fingers when playing, are now covered with ivory, celluloid, artificial ivory, and bone. Time was when a few of the cheaper class of instrument keys were faced with sycamore and French-polished; but the better class were always covered with ivory. But now, owing to the scarcity and consequent increasing cost of this beautiful material, with its pearly whiteness, coupled with an increasing demand for these popular instruments, makers have of late years been compelled, in order to enable them to place their goods within reach of all without unduly increasing the cost of the same, to seek for some other covering than ivory that shall fulfil the same purpose—*i.e.*, present a smooth, bright, white surface. The covering now chiefly used for the cheaper and medium-priced instruments is called celluloid, though some—and particularly the German—manufacturers use bone, which, being well bleached and well polished, is hard to detect from real ivory.

Changing Colour.—Unfortunately, ivory

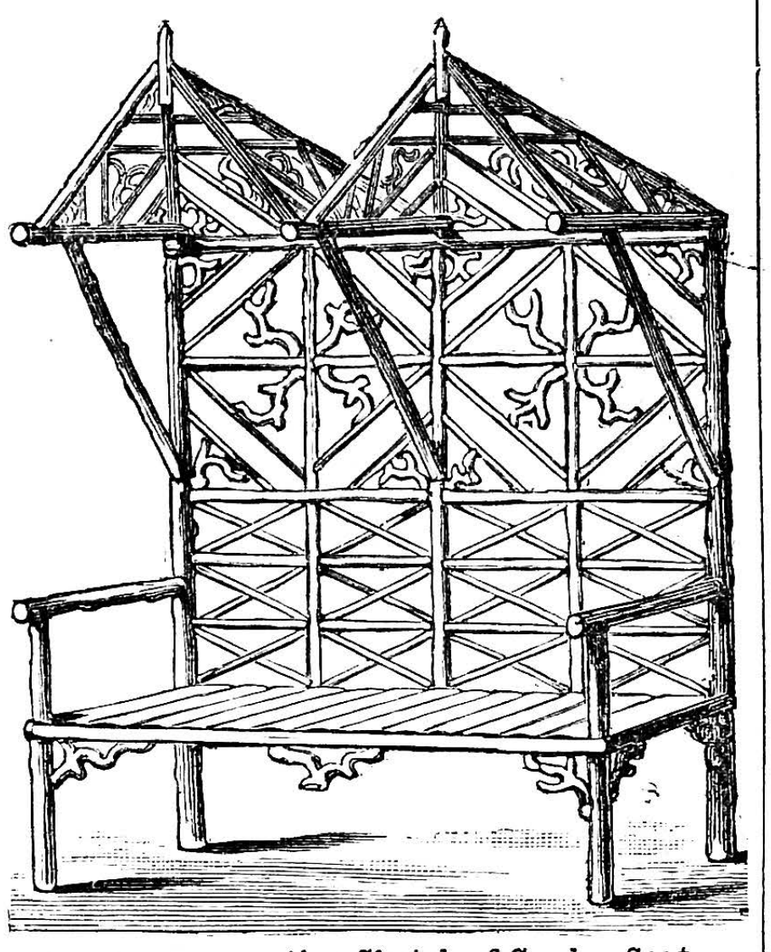

Fig. 1.—Perspective Sketch of Garden Seat.

and its cheaper rivals will not for ever retain their pure white colour.

A correspondent, writing for advice on the subject of pianoforte keys, said "they had turned a beautiful yellow colour: if he could restore them to their natural whiteness, it would make his instrument look twenty years younger." The writer has handled thousands of musical instruments in his day, but has never yet met with one that, by this simple process of whitening the keys, would give this ultimate result; but he can and does say that, in conjunction with French-polishing of the case and well cleaning up the interior, this whitening of keys greatly improves the whole appearance of the instrument.

How to Distinguish.—The distinguishing features of the various coverings used may be briefly said to be as follows:—Real ivory, with age, turns a smoky brown, the colour being pretty evenly distributed; bone may be said to turn a brown, strongly marked in places, also giving a strongly marked veined appearance; celluloid turns a yellow or greenish cast, and is generally most strongly marked in the centre of the key-board, these notes being used more than those at the extreme ends, and appear to be more strongly marked if played upon by persons with perspiring or damp hands. Moreover, they are easily distinguished from bone or ivory by wiping over them a rag fairly wet with methylated spirits, when they will, if made of celluloid, emit a strong smell of camphor.

Bleaching Ivory.—When seeking advice on how to restore the colour of ivory, one is generally told "to wash it, and place under glass in the sun's rays." Now, a little reasoning will show us how this plan—though often adopted, and effective in the case of small ivory figures, brooches, and articles of *vertu*—is impracticable in the case of piano or organ keys, setting aside the fact that in this climate of ours we cannot depend on how long or when we may have sufficient sunshine to answer our purpose. Nor must we overlook the fact that, even if it were possible to wash and place the whole of the ivory under glass, and the sun was powerful enough to bleach them, it would at the same time be powerful enough to—and in all probability *would*—twist the wood-work of the keys into all sorts of fantastical shapes, thus giving us a greater evil for a lesser one—a legacy not at all desirable. Of course, this latter risk might be obviated by removing the ivories from the wood work, when it might be possible to bleach them by the sun's rays, or the peroxide of hydrogen or other bleaching fluids, as used by cutlers for knife-handles, etc. Simply wiping over with spirits of turpentine, and leaving exposed to sunlight, is sometimes found effective.

I point this out as a way in which the ivories might be bleached, or at least improved, though in practice it is never done. If they are so bad as to require such drastic treatment, they are stripped off, to be replaced in most cases by celluloid.

Repairs.—The practical workman—be he dealer, repairer, or tuner—contents himself with replacing by others the most discoloured or worn ones, taking care not to use perfectly white or new ones if the instrument is an old one. Should he not have a sufficient supply of old ivory to select from, the newer ones must be stained to match by wiping over them some strong hot coffee, or other staining medium, previous to polishing. All repairs having been made good, the workman removes from the upper surface of them all a thin shaving, or shavings, till they look of a more uniform colour, and then re-polishing; and in the case of ivory and celluloid it is surprising the improvement this treatment makes to them and the whole instrument, though in the case of bone the improvement is so slight as to make it a doubtful question whether it is worth the trouble to do them or not.

To show to the readers of WORK how the majority of keys can be improved in the most simple and effective manner, with such tools and appliances as can be found or used in the domestic or home work-shop, is the object of this paper, from a careful perusal of which we trust many useful hints may be gleaned, and that none may meet with failure.

To Remove the Keys from Pianos.—It is a good plan to have at hand for these a board about 5 ft. long, 9 in. or 11 in. wide, and at least ½ in. thick. Set this on the top of the instrument, to be convenient for placing the keys on as they are taken out. If it is a cottage or upright piano it is a comparatively easy matter to do this, by first removing the top door, fall, and name-board; then place the white keys only on the board, starting at the right or treble end, taking care to keep them in proper rotation. If it is a square or grand piano, a little more care and observation may be

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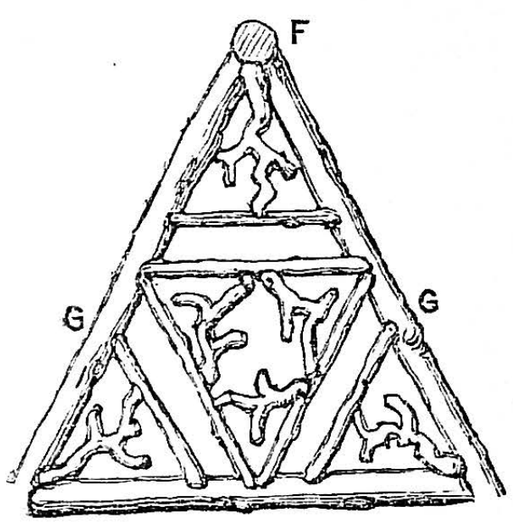
required. It may be necessary to remove the key-frame bodily. To do this, the front slip and screws may have to be removed. It is not always necessary to do this. I point it out because instruments vary so in their construction, some being more complicated than others. Should the key-frame have to be removed, take note of the presence of any bits of cardboard that may be placed under for packing purposes: to omit putting them back again might make a difference in the touch, etc. For this reason it is not advisable to remove the frames if it can be otherwise avoided. Should any difficulty arise in removing the piano or organ keys, it would be a wise plan to watch the tuner, and, if needful, ask him how they are removed.

To Remove Organ Keys.—In removing these, it will be found that, instead of a strip of wood being screwed on the top of the keys, as in harmoniums, a strip, 1 in. or so wide, is screwed to the *back* of the keys, they being grooved to receive it. Printed directions for taking apart the mechanism, to enable one to remove the stop-action, keys, etc., is generally posted up inside the better-class organs. If not, it will be noticed that there are at each end of the stop-rail on the inner side a number of slips of wood, which will require to be uncoupled from the iron cranks, in addition to removing the screws or unfastening the hooks. In the cheaper class it may be only wire bent round, and secured by buttons; but with care it should not be a difficult task to remove the keys from any musical instrument.

To Remove Harmonium Keys.—First remove the stop-rail and shutter-swells (if any), then the narrow strip of wood that is screwed on the top of the keys at the back, watching closely the position and tightness of the long thin screws, as on the tightness or slackness of these depend to a great extent the evenness and springiness of the keys in front.

The flat board, as used for piano keys, is not suitable for harmonium or organ keys, owing to the presence underneath of regulating-screws or coupler-studs. To make this board useful, it will be necessary to nail or screw on two strips of wood lengthwise, at least 1 in. thick and 6 in. apart, or make a frame as will be shown in Fig. 3, particulars of which, with the necessary tools and how to use them, we must reserve for another paper.



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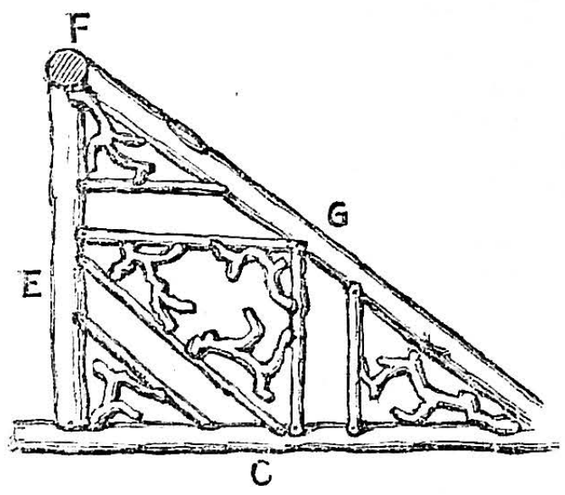

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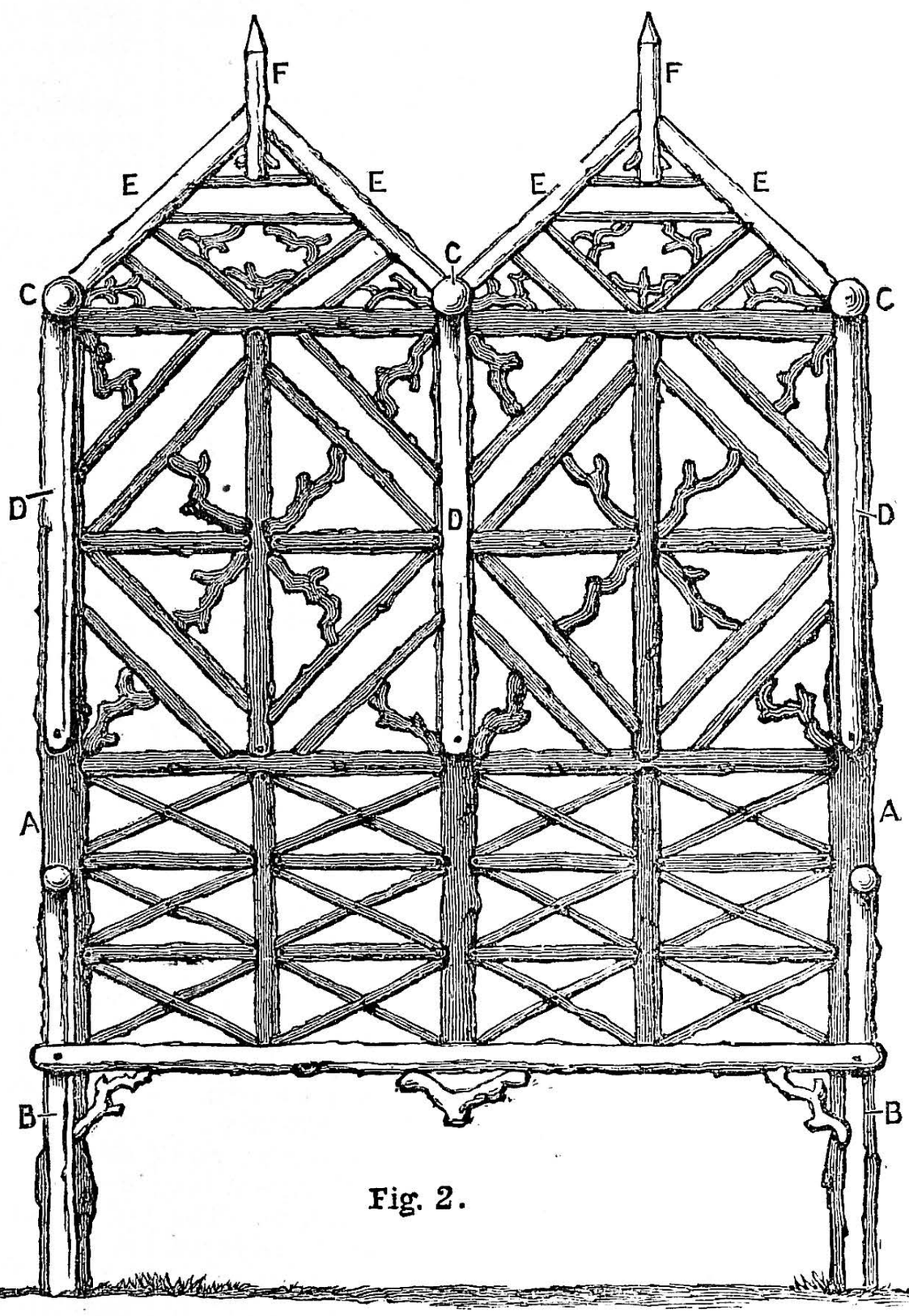

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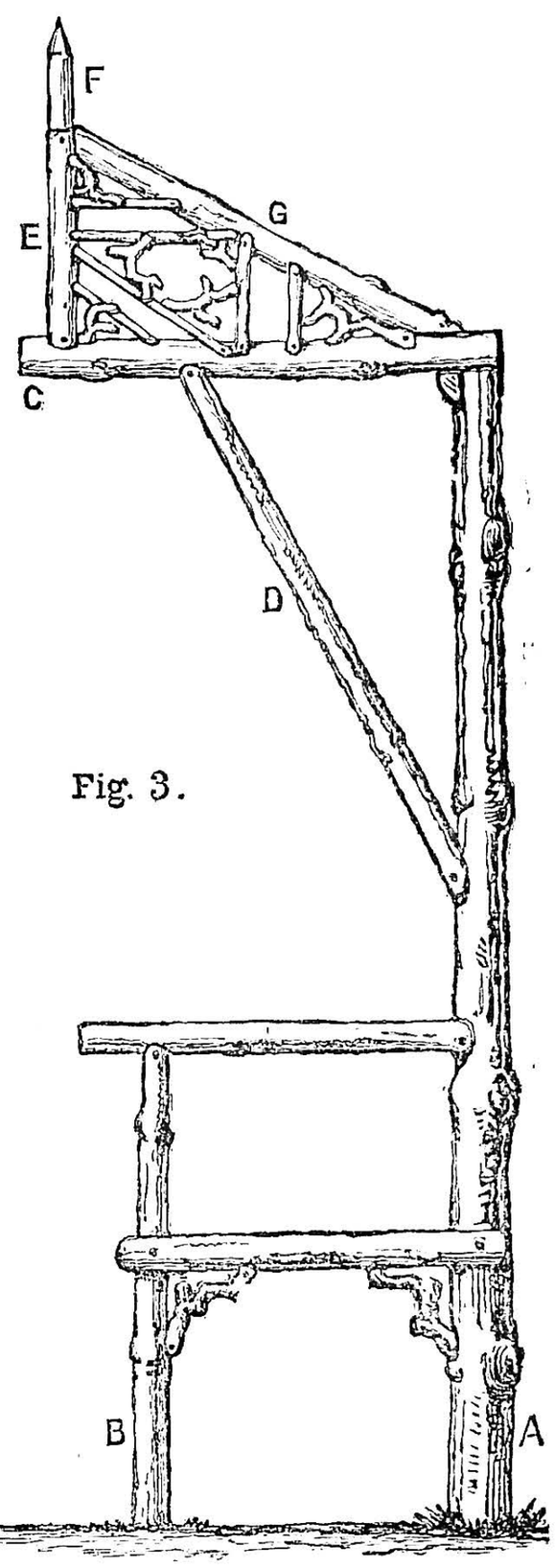

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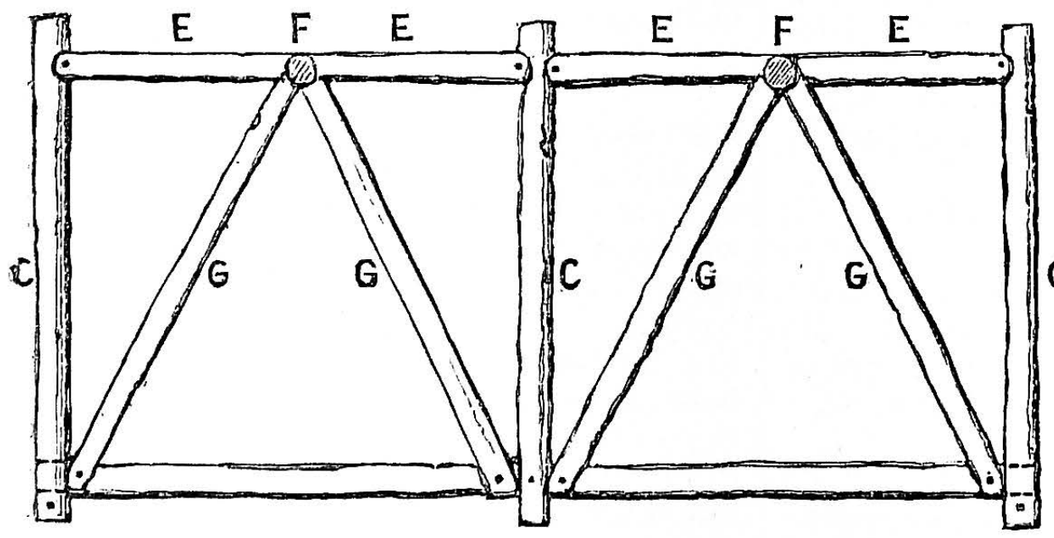

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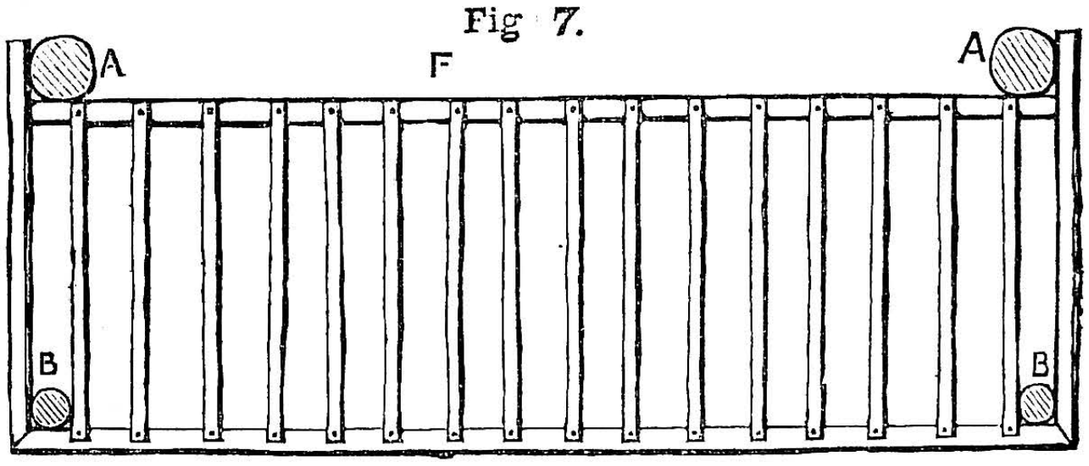

A Rustic Garden Seat. Fig. 2.—Front Elevation. Fig. 3.—End Elevation. Fig. 4.—Plan of Canopy. Fig. 5.—Panel of Canopy: Back. Fig. 6.—Panel of Canopy: Side. Fig. 7.—Plan of Seat.

INDIA-RUBBER collars should not be used in any place where they will be brought into contact with copper, as this metal acts deleteriously upon the substance. Iron, nickel, and tin have no action at all upon it, and lead very little.

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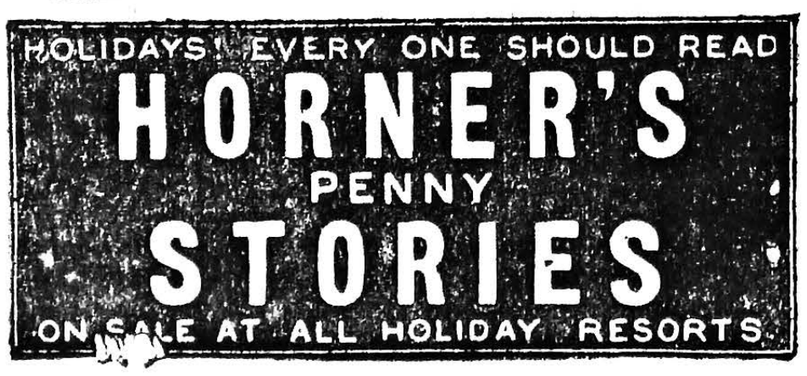

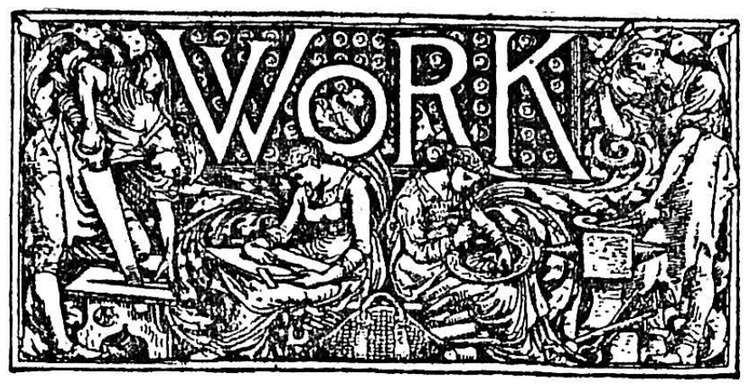

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*** All letters suggesting Articles, Designs, and MS. communications for insertion in this Journal will be welcomed, and should be addressed to the Editor of WORK, CASSELL and COMPANY, Limited, London, E.C.

CHICAGO EXHIBITION.—Although made a free space exhibition to intending English exhibitors at the cost of £60,000 charge on the British tax-payer, it does not stimulate the manufacturers generally to promise to send exhibits. At Leeds, after an effort, it seems to have fallen back to its starting-point of intention to avoid expense of transit, cost of attendance at Chicago, and having to pay heavy Customs charges if the goods shown are sold in the States. The United States Government have displayed an illiberal spirit in this particular; and British tradesmen, who could send some of the finest exhibits in the world, generally refuse to entertain the idea of exhibiting, and decline a lecture on the subject volunteered by the United States Consul's representative. England is paying dear in trying to teach Uncle Sam a lesson in international courtesy and amity, which will long remain a sore point. To have waived the import duty would not have been a loss to the States, as the people would have had the advantage of goods of the highest class to copy or improve upon.

JEWELLERS' EXAMINATIONS.—We have had submitted to us a copy of the examination questions set by the City and Guilds of London Institute in the ordinary—that is, the elementary—grade of goldsmiths' work, etc. The questions, as a whole, certainly convey one impression, and that is, that the subject is not being played with. The questions form but half of the examination, the other half being devoted to the production of a piece of mounted work, or a piece of chased or engraved work. We feel sure that there is a future before the classes held under the supervision of the Institute; and when the results of the examination are published we shall note the relative positions of the four places that held classes during the winter and sent up students for this examination.

BEAN-FEASTS.—Just now a few words about these "outings," of which perhaps the most generally conspicuous feature is that "beans" do not appear on the board, may be seasonable. The name remains from the days when broad-beans and bacon formed the staple dish, and Brockley Jack was dear to the hearts of London operatives. Improved means of locomotion take them further afield now, and in many cases the railway saloon-carriage displaces the "brake" or "waggonette." This annual meeting of employers, managers, and workmen has a greater significance than appears upon the surface: it implies a social *réunion* which rubs off any asperities that may have arisen amongst its members, and reduces the tendency to future friction. Those engaged in the earnest work of this world know that between managers and men there must necessarily arise some strained feeling. The former, in studying their employers' interests, must be strict with the men under their control; and the latter feel it, and sometimes think that they are not sufficiently considered. We are not now dealing with cases where there is obvious tyranny on one side or neglect of work on the other, but only with the ordinary run of business in which fair dealing prevails. When managers and men have met and spent together in common friendship a pleasant holiday they think better of one another. Each man's natural disposition shows itself—the restraint of duty is thrown off, and the workman finds that, after all, his foreman is a very pleasant fellow, and a kind one; and, on the other hand, the managers find their men generous in sentiment, and replete with good feeling one towards another and towards themselves. When the employers themselves join the gathering the men are naturally enough pleased; but, to keep to the particular use of these meetings, we must remember that the unpleasantnesses and jealousies are not, as a rule, between the employers and employés, but between the latter and their managers, with whom, in the ordinary course of affairs, they come in contact daily, and it is towards the removal of lingering discontent that annual holidays of the bean-feast type tend, besides affording healthful holidays and recreation to those who take part in them.

OBJECTS FOR THE MICROSCOPE.—There are many diverse opinions as to the best way of killing insects intended for microscopic mounts. The first object is to avoid giving any unnecessary pain, and also to avoid struggling, which, in the case of moths and butterflies, would lead to disarrangement of the feathery scales on the wings. It has been asserted that piercing an insect through the centre of the thorax with a needle dipped in nitric acid will cause instantaneous death, but there seems a strong likelihood of great pain being temporarily inflicted. The question of causing painless death is one that cannot be settled with absolute certainty, as there are no means of ascertaining the sensations that attend death, but, to all appearance, chloroform gives a satisfactory result. The insect to be killed may be put under a tumbler or bell glass with a piece of blotting-paper previously soaked in chloroform; when this method is adopted there are no disturbing struggles. Possibly among our large number of microscope workers there are some who may care to ventilate this question. Fresh specimens and examples must necessarily be forthcoming. It is desirable, however, where animal life is concerned, to be merciful in the highest degree.

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HOW TO MODEL, BUILD, AND FIT A PORTABLE STAGE.

BY W. CORBOULD.

THIS stage is to fit a small or large room, for comedies, farces, and other amateur performances.

The first part of the work would be to lay the stage. This should be solid and strong. For this purpose the joists and all the supports must not be less than 4 in. by 3 in.

Take the stage at its smallest dimensions—say 12 ft. square. It would be a small room indeed where the stage would want to be less. My intention is to start at this figure, making it to extend to 24 ft. by 20 ft.—as large a size as would be required for any amateur performance.

The front elevation should be 3 ft. 6 in., and must rise ½ in. to the foot towards the back, so every row of supports must be 1½ in. longer than its front one. If the stage were extended to its full depth, it would be 10 in. higher at the back than the front. This gives the necessary slope. I have seen stages much higher, but ½ in. to the foot is quite enough.

Fig. 1 shows the under work, standing, as it would, at 12 ft. square. 1, the front of the stage, showing the first two trestle-like supports. These are 12 ft. long, having four supports, each 3 ft. 2 in. high, one at each end and one 3 ft. from each end. The middle strut is one of the supports of the centre beam, 3. When fixing the stage, this would be the first to put up. 1, 2, 3, 4, and 5 are placed over 3, standing 3 ft. apart, firmly bolted together by clamps and carriage-bolts, "about 4 in." (see A, B, Fig. 1A). All these trestles, it will be seen, are double. If one be drawn 3 ft. one way, and the other the

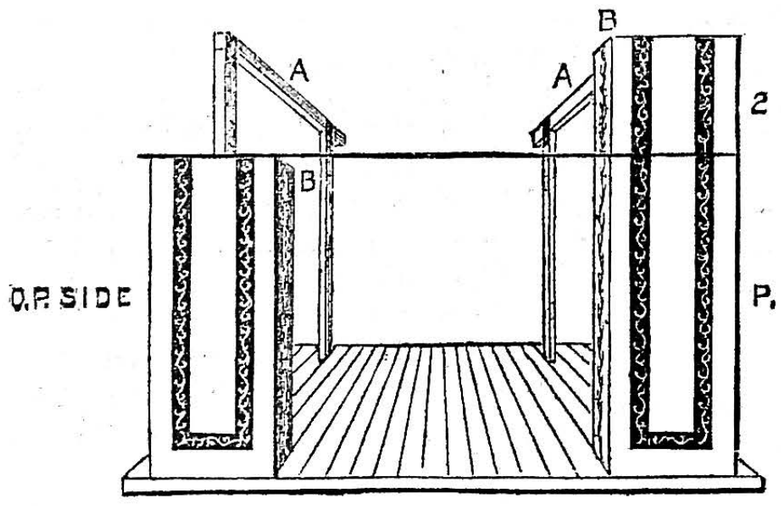


Fig. 6

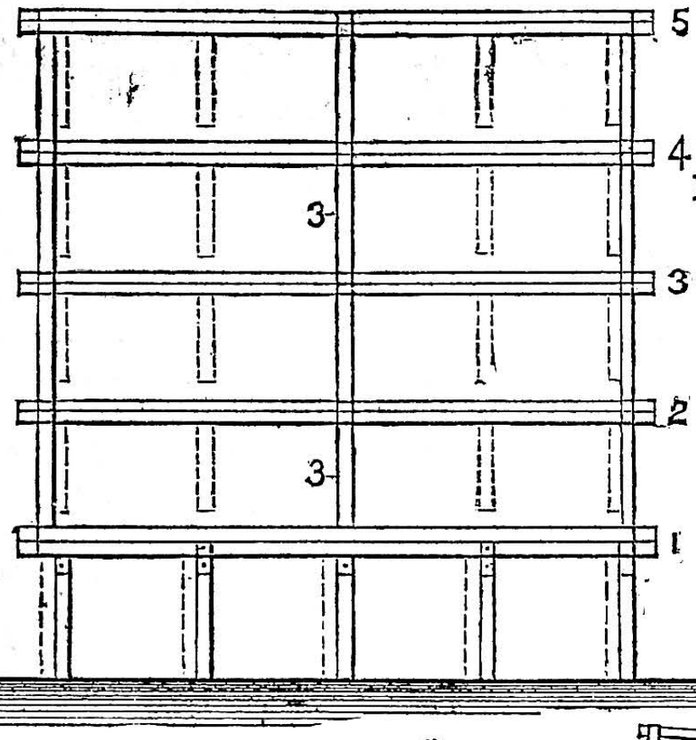


Fig. 1.

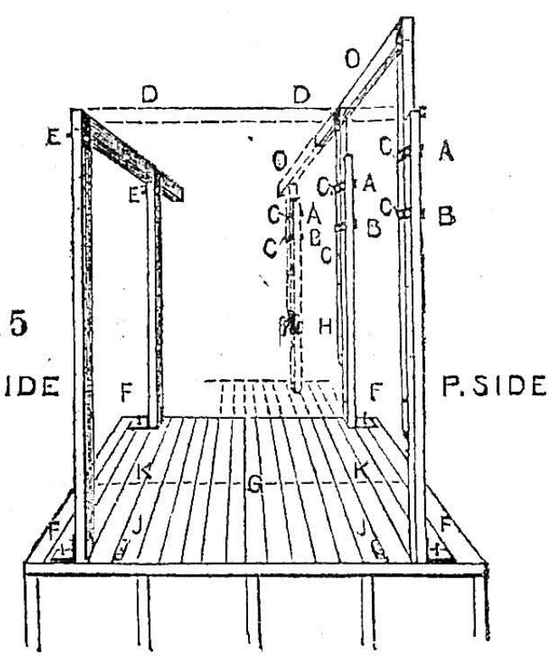


Fig. 5

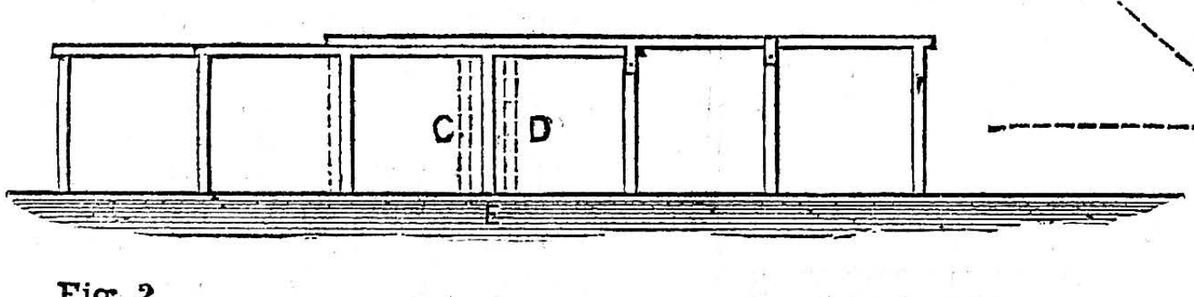


Fig. 2

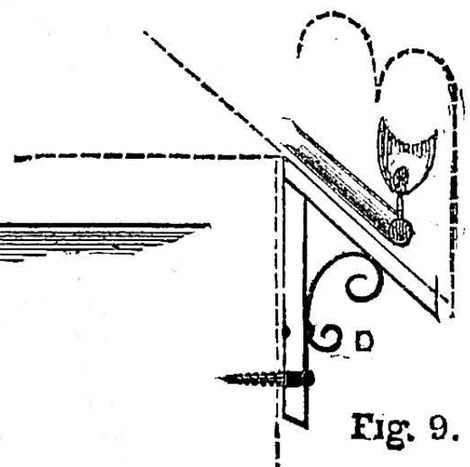
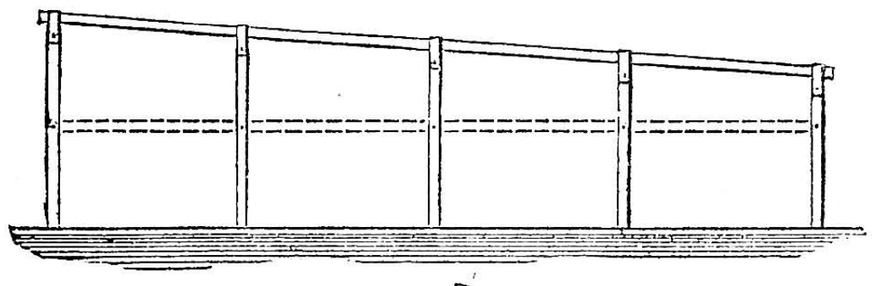


Fig. 9.



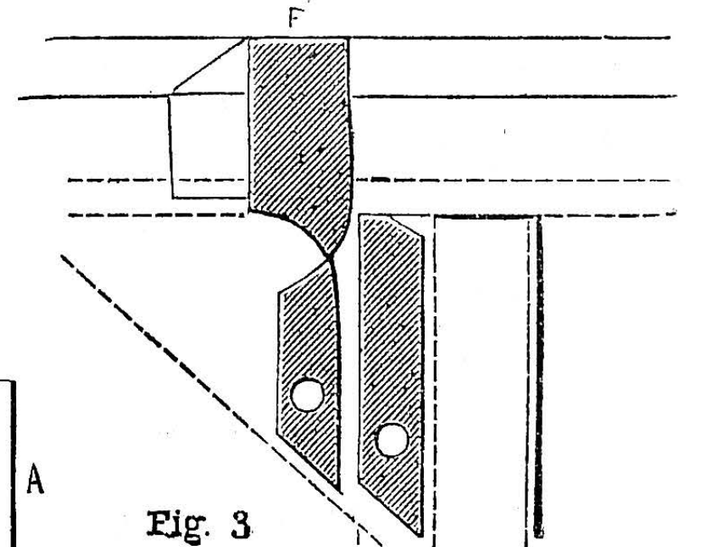


Fig. 3

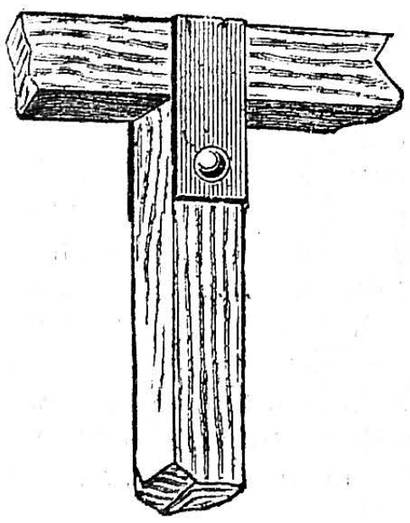


Fig. 4.

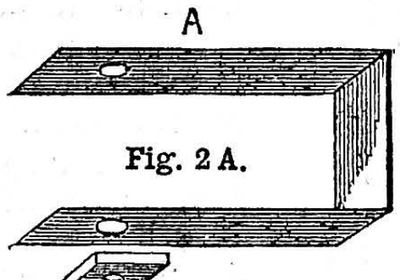
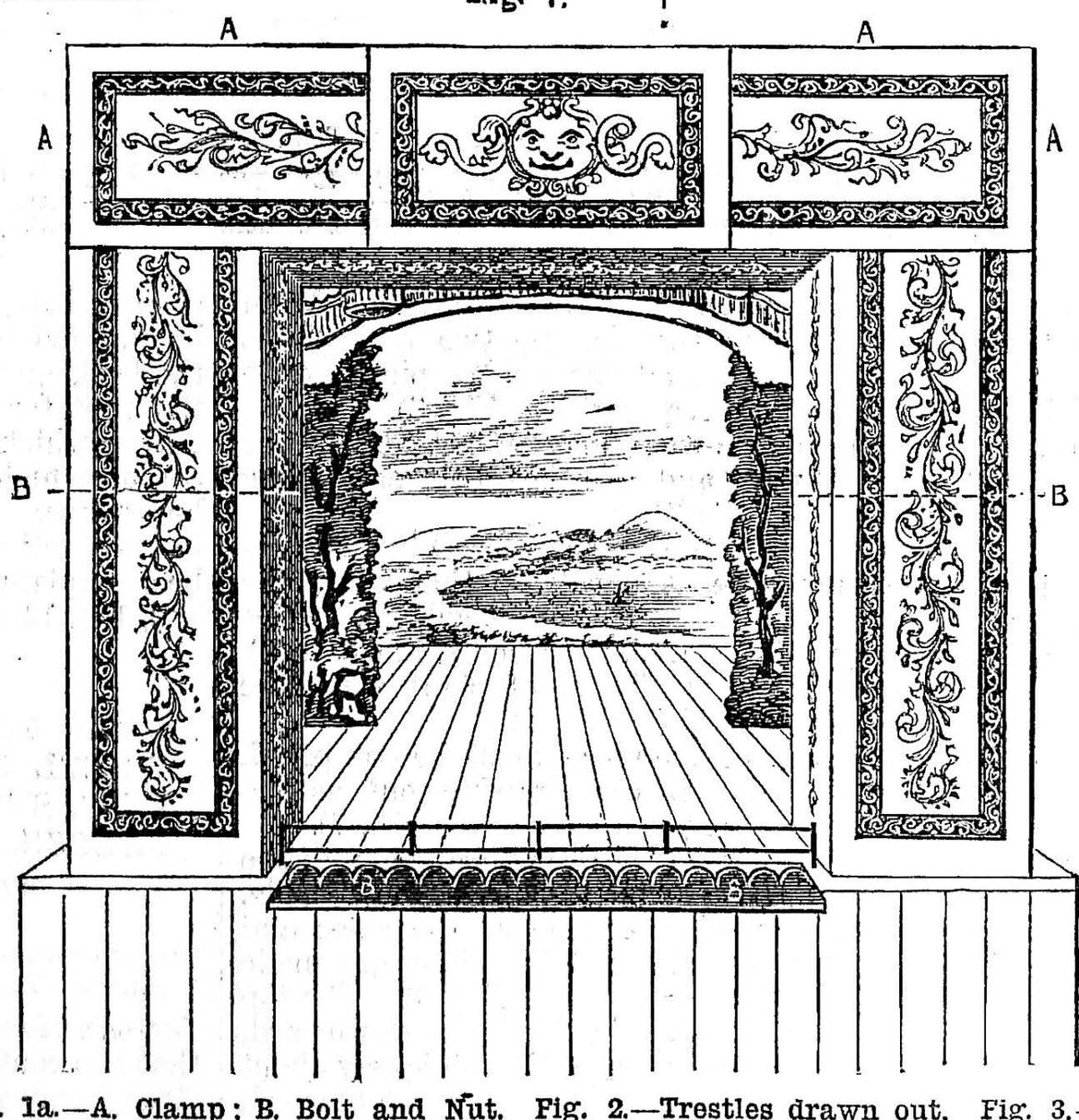


Fig. 2 A.

Fig. 7.



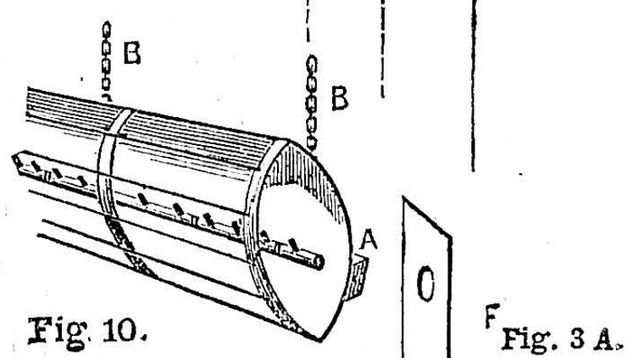


Fig. 10.

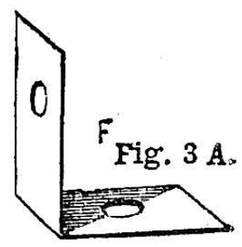
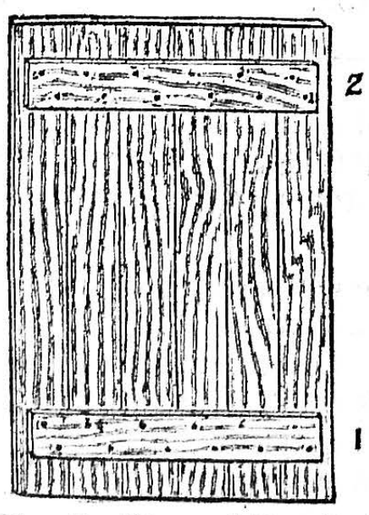


Fig. 3 A.



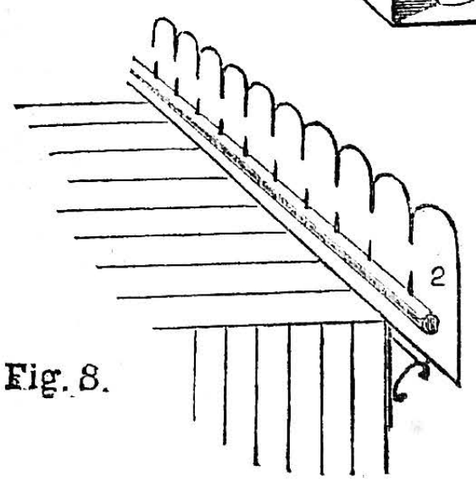


Fig. 8.

Fig. 1.—Position of Trestles. Fig. 1a.—A. Clamp; B. Bolt and Nut. Fig. 2.—Trestles drawn out. Fig. 3.—Twisted Clamp, where Clamp A and B would be useless. **Fig. 3a.—Clamp or Knee Bracket for fixing Upright Timbers to Stage Floor.** Fig. 4.—Section of Flooring. Fig. 5.—Method of shifting Framework. **Fig. 6.—Proscenium Front attached to Framework. Fig. 7.—Stage Complete.** Fig. 8.—Footlights: Side View. Fig. 9. —Footlights, supported by Bracket D. **Fig. 10.—Gas Battens. Fig. 11.—Side Elevation of Trestles, showing the Fall from the Back to the Front of the Stage (Dotted Lines, a Piece of Stuff 3 by 1 in. screwed to Supports by small Bolt and Nut, to keep all steady).**

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same distance the other side, you would get a stage 18 ft. wide (see Fig. 2). This would bring supports C D close to centre. If you wanted to make the stage wider still, it is obvious that C and D supports would not pass the centre one, E; therefore, they would have to be taken off and shifted, and when the trestles were drawn out as far as required, would have to be put back again, dividing the spaces equally (see Fig. 2). The stage would now be 23 ft. wide. This would be ample for anything; but if the room was wider than that, a curtain hung on each side to close in the intervening space would have to be put up. We should want from ten to fourteen of these trestles when the stage was larger than 12 ft. square, but if the stage was only 12 ft. square, five trestles might do. One or two clamps, bolted through as shown at F, Fig. 3A would be needed. These clamps differ from Fig. 1A clamp in being only half the length one side, the other half being twisted, to bolt flat against the centre beam, 3 (see Fig. 1). Dotted lines indicate timbers.

Should the stage be opened to its fullest extent, the two back trestles would be 4 ft. apart, instead of 3 ft., as the others, thus adding 8 ft. on to the 12 ft., making the stage 20 ft. deep. This difference in the width of the trestles would not matter regarding strength, as the back of the stage is not used so much as the front and centre.

We ought now to be ready for the flooring; and this wants special care in the making. Inch floor-boards, which generally run about $\frac{6}{8}$in. or $\frac{7}{8}$in., must be used. Saw them into 6 ft. lengths; take six of them, lay them side by side (Fig. 4); place two cross-pieces (see 1 and 2) $3\frac{1}{2}$ in. from each end; screw this together with $1\frac{1}{2}$ in. screws, two for each board. The piece, when finished, would be 6 ft. by about 3 ft. If you now lay this piece on the trestles, it should fit so that the two cross-pieces, 1 and 2, are inside the trestles—that is, the edges of the boards should rest on the trestles, each piece of flooring butting each other closely. I am particular in explaining this, because on its fitting depends a firm stage to get about on, which is important. For a 12 ft. stage four of these pieces would fill the front half and four the back half—eight altogether. If you make the stage 3 ft. wider, you would require two more, and so on: fourteen such pieces for the full stage of 24 ft. The two back rows would only have to be 4 ft. lengths, made the same way as the others, so that the stage may be made 4 ft. or 8 ft. deeper.

Having our stage fixed, we now come to the fitting of the framework, to carry proscenium, scenery, etc. etc. The four principal uprights should be 3 in. square, and the two top beams 5 in. by 3 in. (see Fig. 5). The two uprights should be divided into two pieces, of about 10 ft. long each. These should work telescope fashion, by having two clamps with a bolt and nut through the both posts, holes being bored through the top piece about every foot or nine inches. This top piece will slide up or down, according to the height you wish to have the proscenium. A and B are the two clamps; C the bolt. The top beam, O O, is worked the same way. These ought to be 12 ft. each in length, to prevent bending or sagging when the weight of scenery, battens, etc., are on them.

This system of telescope working is applicable, and must be adopted in the sides and top of the proscenium in the way I will describe.

In the first place, make four pieces, 8 ft. high and 2 ft. 6 in. wide, made in frame-work (see "Stage Carpentry," WORK, No. 140). One piece will work behind the other, so that it may rise up. Should it be required to make the proscenium higher, you will see the back piece may rise 6 ft. or 7 ft., bringing the top of the proscenium nearly 20 ft. higher (see Fig. 6). A bolt on each side of the frame-work will keep all right.

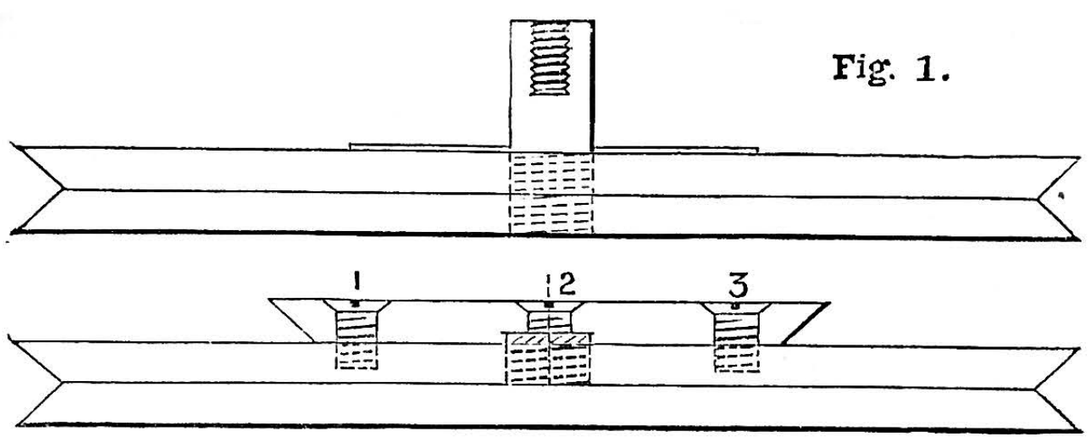

Fig. 1.

Fig. 2.

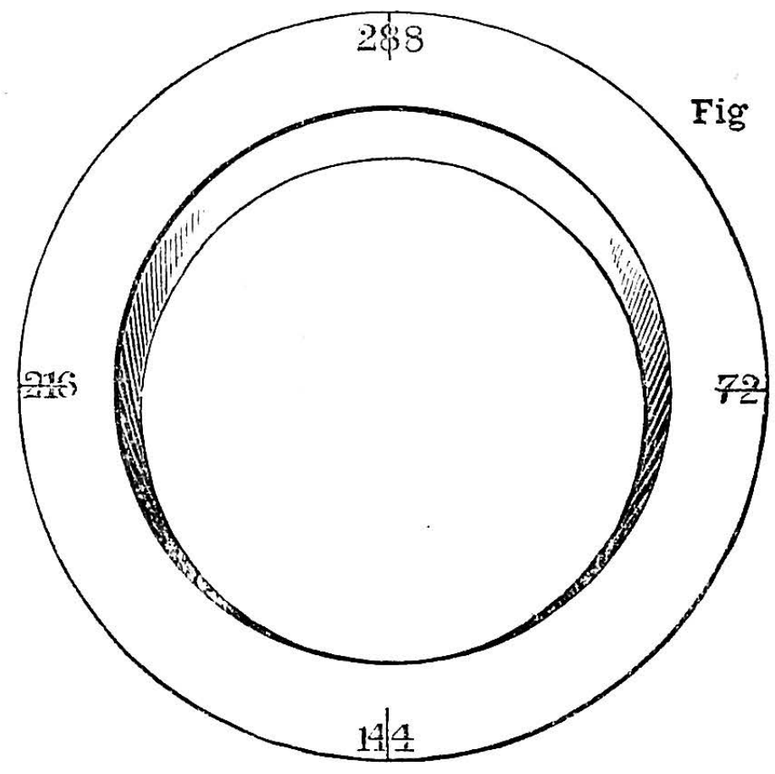

Fig 3.

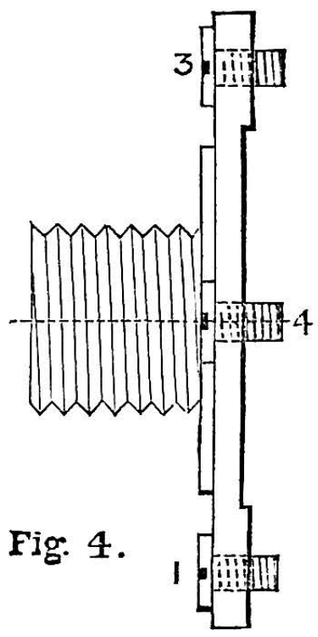

Fig. 4.

Improved Arbor for Front Dividing Wheel of the Elliptic, Eccentric, Straight-Line, and Dome Chucks. Fig. 1.—Old-fashioned Arbor or Pin on which the Dividing Wheel is rotated. Fig. 2.—Improved Arbor. Fig. 3.—Dividing Wheel. Fig. 4.—Nose of Chuck.

We now make the top, which must be in three pieces—that is, the two end pieces must slide behind the centre piece, to be drawn out as required (see Fig. 7).

This frame-work may be fastened to the upright posts and cross-beam either by tying with cord or bolting.

In the painting of the proscenium the design must be as panels, so that when the back piece is moved up it will merely be making the panel longer (see 2, Fig. 6, A, A). Frame-work is all out of sight when the stage is finished (as Fig. 7).

The top centre-piece must be one panel, the two side pieces drawing out as required, forming two panels (see Fig. 7).

Sometimes return pieces are made to the proscenium, about 12 in. or 14 in. wide. These are made the same as the sides and top. The top pieces of the sides are made sloping downwards (see B, Fig. 6). The top piece thus, when fixed, slopes downward, the two side pieces standing obliquely about 4 in. or 5 in. (see B, Fig. 6). A piece of wood, about 1 ft. long and 2 in. by $1\frac{1}{2}$ in. square, screwed to the stage behind these side pieces as "cleats," the sides can be fastened to them (see J, Fig. 5). These return pieces may be painted as panels or columns.

This diagram (Fig. 5) shows the supporting frame-work of the whole of the scenery, proscenium, etc. You will see it is essential that it should be strong and well put together. The O P side shows only the two uprights and cross-beam, clamped and bolted together at E E, and fastened to the stage by a bracket similar to that shown at F; while on the P side the frame-work is raised up 3 ft., making the proscenium front higher, the clamps, A and B, keeping them as one solid piece, the bolt, C, being shifted according to the height required. The dotted lines show the position of upright H when shifted farther back to make the stage larger. It will now be seen that if the top beam is in two 12 ft. lengths, when fully drawn out to 20 ft. will give 4 ft. of double thickness in the middle. This would prevent them giving with the weight. Dotted line, D D, is a piece of stout quartering fixed across the front, carrying the top of proscenium. Dotted line, K K, shows the 6 ft. lengths of flooring: their division across the stage.

Fig. 7 shows the stage complete, B B dotted line showing the two parts—of course, decorated according to the taste of the artist; only, it will be seen at a glance, the running scroll-work is the best, because in lengthening out the design is not altered. The panels might be a pale blue or green, the styles a warm pink, the scroll-work in old gold. Now as to the manner of fixing the foot-lights, s, s. A board about 8 in. or 9 in. wide should be hinged on to the front of the stage, sloping downwards (as shown at Fig. 8); the gas-pipe lying in the bottom—bringing the lighted burner very little above the stage floor (see Fig. 9). D is an acute angle bracket, screwed to the front of the stage, as many being required as will carry the footlights—one about every 3 ft. The burners or gas-jets should be about 6 in. apart. The end of the end of the gas-pipe may be connected by indiarubber tubing; so, likewise, the gas battens in the flies. These should be guarded by a shield of sheet-iron over the back and four or five stout wires along the front, for safety (see Fig. 10). A is a stout batten which the whole is fixed to; B B are chains which the battens must always be hung with. The fixing of all the other parts in connection with the scenery, etc., has been explained in "Stage Carpentry," Nos. 140, 144, 149, and 154.

ARBOR FOR THE FRONT DIVIDING WHEEL OF THE ELLIPTIC, ECCENTRIC, STRAIGHT LINE, AND DOME CHUCKS.

BY NORMAN MACLEAN.

INTRODUCTION—OLD STYLE ARBOR—IMPROVED ARBOR—THE NOSE OF CHUCK—CONCLUSION.

Introduction.—It is generally acknowledged that the central pin shown in Fig. 1 is not strong enough for the work done nowadays by professional and amateur turners, and I propose to show, without taking up

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too much space, how the improved arbor is in many ways superior to the old-fashioned central pin. It is well known that (for instance) the farther the slides of the eccentric chuck are from the central position, the greater the strain upon the central pin (Fig. 1), and if unfortunately the chuck meets with any obstacle, something has to give way, and this is generally the central pin. There is another device for providing for the proper rotating of the front dividing wheel—viz., the insertion of a tightening screw in the base of the front slide, which, I think most objectionable. Supposing the screw to be too tight, one is unable to turn round the wheel without great difficulty, and in the case of a click wheel, one dodges backwards and forwards in the vain endeavour to drop the click into the right notch; the other unpleasant alternative being that if the binding screw be too loose, the click "chatters" in its notch, and spoils good work, to say nothing of the inconvenience of taking the chuck to pieces to get at the binding screw in the base of the front or transverse slide.

Old Style Arbor.—Fig. 1 shows the old style of central pin, and needs no further description.

Improved Arbor.—This is illustrated by Fig. 2, and consists of a steel disc shaped like the sketch. My readers will note that there are traces of the old central pin, which has been cut off to within ⅛ in. of the surface of the front slide of the eccentric. This fits into a recess turned in the base of the steel disc, which is secured to the slide by three screws, 1, 2, and 3, and which are let in flush with the surface of the disc.

Fig. 3 shows the dividing plate. This is turned out to fit the angle of the cone of the steel disc, and is then placed on the slide of the eccentric chuck, the steel disc dropped into its position and screwed home, when it will be found, if the work is well done, that it can easily be turned in either direction.

The Nose of Chuck.—This, of course, necessitates the nose of the chuck being in a separate piece (Fig. 4), and which is fixed in position by means of four screws, 1, 2, 3, and 4, each screw having a small turned washer between the head of the screw and the plate of the nose. As the making and fitting of the nose dead true is a difficult matter, it would be perhaps better if the four holes in the plate of the nose were slightly slotted to allow for final adjustment before the screws are tightened up.

Conclusion.—I do not claim anything for this improved arbor. I regret being unacquainted with the name of the maker, as the chuck was bought some ten years ago second-hand, but during that time it has stood the test of some of the heaviest work I have ever executed, and whatever weakness it may have exhibited in other parts, it has certainly come out of the trial with credit to itself and with honour to its inventor.

[Possibly, with this description, some among our numerous professional and amateur turners may recognise this arbor, and let us know. On the principle of "To every man his due," the maker's name ought to be made public.—Ed.]

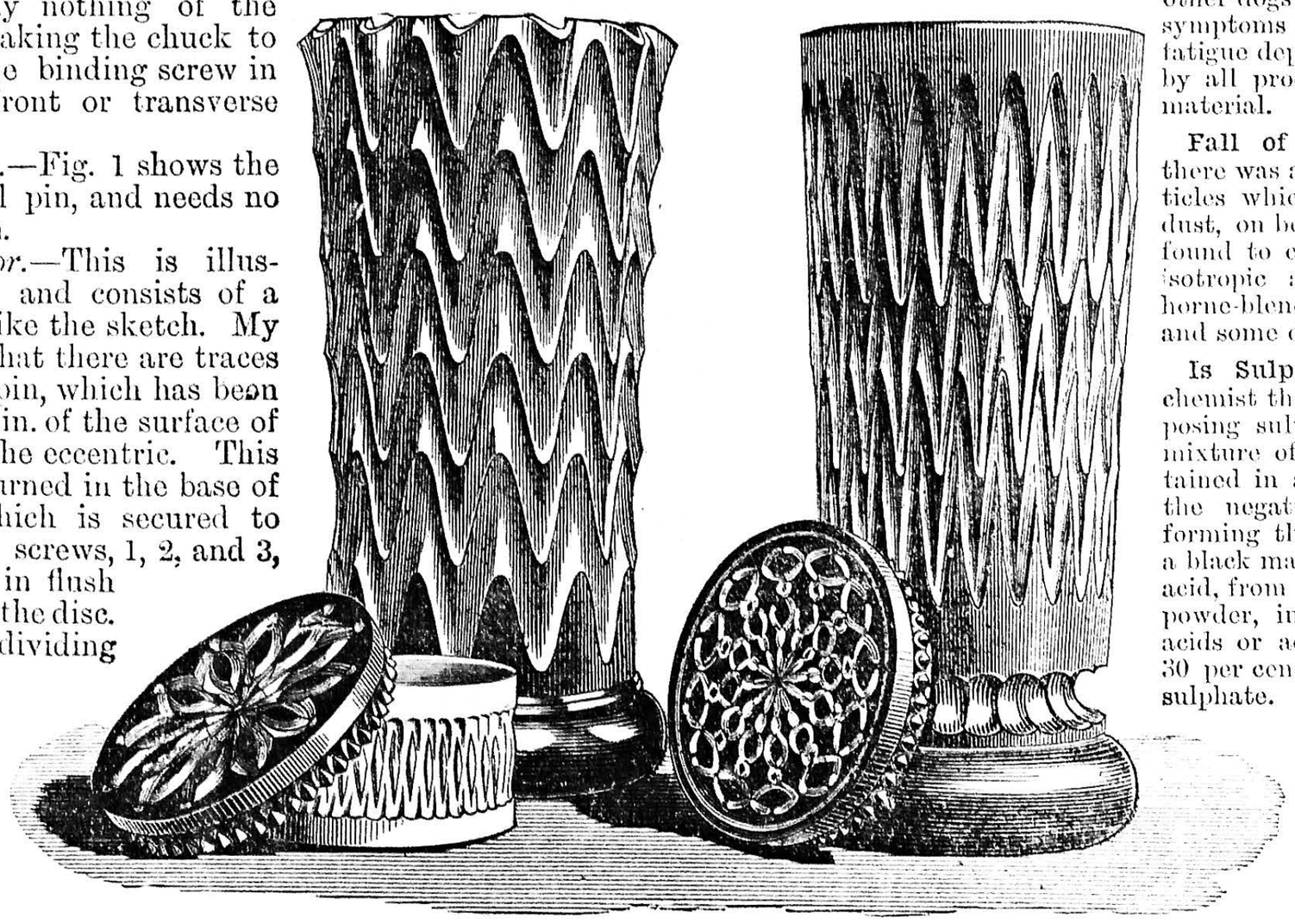
SOME NOVEL TURNING.

BY F. A. M.

The spill-cups, napkin-ring, and box shown in the drawing were produced upon an ordinary 5 in. screw-cutting lathe, by a tolerably simple appliance. My lathe is not intended for ornamental turning, as, when setting up a workshop some years ago I found that lathes for ornamental turning were much more expensive than those made in quantities for the ordinary work of an engineer's shop; also that the ornamental lathe was not suitable for anything but the smallest metal work, whilst the engineer's slide-lathe furnished the means to make any kind of additional apparatus; and in making and contriving such apparatus is to be found far more exercise for ingenuity even than in using it.

Most ornamental turners buy a beautiful and expensive set of apparatus partly for the sake of the pleasure that comes from owning and handling beautifully-made and exquisitely-finished appliances. This may be a very innocent way of obtaining enjoyment and recreation for a rich man; but it does not often make a good workman. A far cheaper, and, as it seems to me, a better plan is to follow the line I have indicated. Begin with an honest slide-lathe at about £30, then buy no more finished apparatus but only the castings, planed; take one thing after another—say, the overhead motion, eccentric cutter, vertical cutter, universal cutter; make these by degrees, and you will not only become possessed of a capital set of apparatus, but will also become a good workman, competent to use them.

The examples given above were made on the suggestion of a very clever American amateur, F. N. Massa, Esq., from whom I have obtained many good ideas; it has some advantage over the more ordinary kind of ornamental work in which the constant recurrence of the circle becomes rather wearisome. I hope the curiosity of my readers will be excited when I tell them the first work of this kind was done without any addition to my lathe beyond a piece of wire, some pullies, and a weight (the headstock). I had, however, overhead motion, driller, and a pin fixed as in one of the change wheels. This was, of course, a makeshift, yet it produced a nice-looking pattern, which would be thought to have required the pumping motion of the mandrel of a rose engine. The present examples were done by means of a home-made appliance, which may give as many as 96 waves in going round, and may make them 1½ in. long. The appliance is applicable to almost any slide lathe, and need not cost more than about £6. Instead of taking out a patent for it, I propose to describe it in Work by-and-by.



Some Novel Turning. Spill Cups, Napkin Ring, and Box.

SCIENCE TO DATE.

Fatigue.—Professor Mosso, of Turin, has discovered that the blood of dogs fatigued by long racing acts as a poison, and when injected into other dogs causes the latter to exhibit all the symptoms of fatigue. Hence it seems that fatigue depends more on a specific poisoning by all products than upon a deficiency of material.

Fall of Dust.—In Stockholm recently there was a fall of hail mixed with dust particles which lasted for several hours. The dust, on being collected and examined, was found to consist of glassy material, both isotropic and anisotropic, together with horne-blende, magnetite, mica, metallic iron, and some diatoms.

Is Sulphur an Element?—A German chemist thinks he has succeeded in decomposing sulphur. By electrolysing a fused mixture of barium sulphate and nitre contained in a silver crucible which served as the negative electrode, a platinum wire forming the positive electrode, he obtained a black mass partly soluble in hydrochloric acid, from which he isolated a greyish-black powder, insoluble in nitric or hydrofluoric acids or aqua regia. It represented about 30 per cent. of the sulphur contained in the sulphate. He thinks that sulphur is, therefore, a hydrogen compound which by electrolysis loses hydrogen.

Curious Limestone.—In the valley of the Hirnant River, which flows into Lake Bala, there is a band of a black oolitic limestone. The blackness is due to a coating of carbon which the oolitic grains possess. Under the microscope they are seen to be made up of four layers: (1) a central nucleus; (2) a layer of carbon; (3) an outer cap of silica; and (4) another thin layer of dusty material. It is possible that the carbon in this rock, which is of Ordovician age, is due to vegetable agency.

NOTES FOR WORKERS.

The late Prince Louis Lucien Napoleon has left to the nation his valuable collection of metals, which have been placed in the Science Museum, South Kensington. The collection is rich in specimens of the rarer metals.

Rubber may be deodorised by dipping it into a solution of salicylic acid in alcohol. The solution is made by dissolving 20 grains of salicylic acid in half a pint of alcohol.

A French chemist has found that aluminium can be used instead of magnesium by photographers for producing an intense light.

The momentum, or amount of motion, of a body is found by multiplying the mass in grammes by the velocity of the mass in centimetres per second. Thus, a mass of 100 grammes, moving with a velocity of 5 centimetres per second, has a momentum of 500.

To preserve pencil drawings, paint them with a thin wash of isinglass, which will prevent the black lead being rubbed off.

Hops were introduced into America about 250 years ago. The greatest producing State is New York, which in 1889 had 36,670 acres devoted to this crop, the production being 20,063,029 lbs.

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TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

CUTLERY TRADE.—In the Sheffield cutlery trades there is very little change. The strike at Rodgers' continues.

COTTON TRADE.—The threatened crisis in the cotton-spinning industry is delayed for some days, owing to a want of unanimity on the part of the employers, some of whom favour a 5 per cent. reduction of wages and others 10 per cent.; all are agreed, however, that a reduction must occur before a trade revival can be expected. So far as Oldham is concerned, 85 per cent. of the employers are in favour of a 10 per cent. reduction; while in the Rochdale, Ashton, and Stalybridge district 40 per cent. favour this movement. In the Bolton district a reduction of 5 per cent. is considered sufficient to meet the requirements of the case, and as soon as 80 per cent. of the employers agree to this course being taken, notice of the proposed reduction will be sent to the operatives' associations. In North-east Lancashire the situation is critical, and short time is considered inevitable in this district. Many manufacturers are without orders, and machinery is being gradually stopped.

SILVER AND BRITANNIA METAL TRADES.—While the silver trades are dull, the Britannia metal trade is improving.

FILE TRADE.—The pressure of the Spanish and Portuguese duties has caused a lull. A few weeks ago the Peninsula was flooded with articles, good and bad, and some time must elapse before the altered conditions of trade can be measured with accuracy.

STEEL TRADE.—In the crucible steel trade prices are well maintained, and will probably advance as trade increases. The rolling mills are not so well employed.

BUILDING TRADE.—Our Rochdale correspondent writes:—The harmony in this trade has now been broken by the plasterers coming out on strike for an advance of ½d. per hour in wages, which are at present 8d. per hour. The men also demand walking time in all cases, instead of going for their wages in their own time, as at present. Both sides seem firm, and meanwhile all plastering is at a standstill.

ENGINEERING TRADE.—The improvement still continues, and the outlook is promising. Several orders have been secured by the leading machine tool makers, and stationary engine builders are better employed. In the locomotive building branch the prospects are generally regarded as being very slight. Boiler makers are better off for work than last month. The chief machine makers are fairly well employed. In the shipbuilding industry of the Mersey district no change is reported, while in the Barrow district the activity shows signs of slackening. Engineers in the district are also quieter. In the iron trade business is of the hand-to-mouth character. The belief in an immense reduction of prices, which is generally entertained, has the effect of causing consumers to buy only for immediate requirements.

CYCLE TRADE.—The cycle trade of 1892 is on the wane. The 1893 season may be said to have begun, in so far as booking fresh orders is concerned. Many of the cycle-making firms have already their representatives on the move, and good business in Scotland is reported for 1893. Several makers are preparing to put the new geared ordinary on the market, which machine may be expected to come largely to the front in 1893.

TIMBER TRADE.—There have been large sales, including 932 logs and 1,333 curls of mahogany, 396 logs cedar, 1,925 logs satinwood, 226 logs walnut, 1,889 boards maple, 545 planks teak, 28 tons lignum vitæ, 162 pieces Malabar ebony, 6 logs rosewood, 109 planks Bahia rosewood, and other lots. The imports, with some exceptions, have been fairly moderate; the stocks are increased, and, in some cases, are now excessive. Prices are mostly weaker; the attendance at the mahogany sales has been good, and satisfactory prices were obtained.

CHEMICAL TRADE.—The demand for bleaching powder is very great, and the price is from £7 10s. to £7 12s. 6d. Soda crystals, caustic soda, and sulphur are unaltered. South Durham salt is quiet at about 10s. per ton free on board.

TANNING TRADE.—The hide market is without any change, the business consisting of Santa Maria heavy ox at 5½d.; Gualaguaig, 5d.; and Rosario Matadeiro light, 3d. to 3½d. Tanners are very cautious, and complain of the limited demand.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

*** *In consequence of the great pressure upon the "Shop" columns of* WORK, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of WORK *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given.*

I.—LETTERS FROM CORRESPONDENTS.

Arithmetic.—STUDENT writes:—"Let A put down four figures in a line, and allow B, another person, to put a figure as a unit of the amount, as 2. He who adds the 2 may tell at once the exact total of a sum of five rows of figures, of which A puts two more rows and B two more rows, and adds them all together. Thus:—

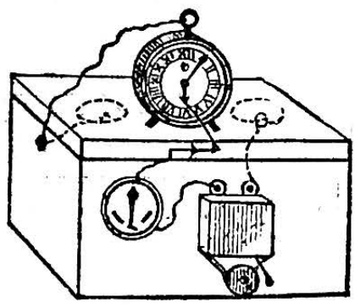
A....	99,992-B
B....	29,999
A....	70,000
B.....	00,007
A....	99,992
Total	299,990

or,

A....	3,692-B
B....	1,000
A....	8,999
B....	0,101
A....	9,898
Total	23,690

B says the amount will be 23,690 as soon as he has added the figure 2 to the first line; the sum shows he was right. How is it done?"

Alarm.—H. F. G. (*Hammersmith*) writes:—"I send you the enclosed sketch of a reliable electric alarm, hoping that it will be of service to some of your readers. Since the last sketch on p. 699, No. 95, Vol. II., the alarm has worn, which they all do after some time, so I have abolished it and have taken the front glass out and bent the wire, A, from the switch so as to just clear the minute hand but come in contact with the hour hand. In sketch I have put it in front of the hour six, which is my time of rising. Of course, it can be fixed in front of any hour, and will keep ringing for an hour according to length of wire across the figures. If the battery box is nicely finished, it does not look amiss on a shelf over the bed within arm's reach for shutting off switch."



Electric Alarm.

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Books on Gas Engines.—H. S.—"On Gas Engines," by T. M. Goodeve, 2s. 6d., deals with the Otto engine. "The Gas Engine," by Dugald Clerk, 7s. 6d.: a very good book. "Gas Engines," by Wm. Macgregor, 8s. 6d. "Gas and Petroleum Engines," by Wm. Robinson, 14s.—F. A. M.

Pressure of Water.—J. J. (*Bromley*).—The pressure of a column of water in pounds per square inch at its base is found by multiplying its height in feet by 0·434. To put it as a formula, let H equal height of column of water in feet, and P equal pressure in pounds per square inch at base; then $P = 0{\cdot}434\ H$; and by transposition $H = \frac{P}{0{\cdot}434}$

Applying this to your case, we have:

$$H = \frac{P}{0{\cdot}434} = \frac{80}{0{\cdot}434} = 184{\cdot}33 \text{ ft.} = 184 \text{ ft. } 4 \text{ in.}$$

—F. C.

Pinion Wire.—J. J. (*London, E.C.*).—Messrs. Haswell & Sons, Spencer Street, or Messrs. Grimshaw & Co., Goswell Road, Clerkenwell; either of these will supply your wants in pinion wire, any number of leaves and any size. Prices run about 6d. per length of 12 in. about.—A. B. C.

Safety Bicycle.—H. W. (*No Address*).—I should be glad to make a machine for H. W. same as design given in WORK, but am not now in a position to do so, having entered upon an engagement with the North British Machine Company. If H. W. pleases to give me his address, I will be glad to forward him their catalogue, and can assure him he will be able to choose a machine of as fine design as anyone could wish for, and as good value as can be had anywhere; or, if he much desires it, I can have one made exactly from my own design, as shown in the pages of WORK, and under my own supervision in the works at Croshill.—A. S. P.

Automatic Door Fastener.—NOVICE.—The arrangement looks complicated, and would probably cost so much that it would scarcely compete with rim latches. It looks rather unsightly, and would demand more careful fixing than ordinary people give to such matters. The only way I should use it is in lieu of the private bolt used for bedrooms, which release with a cord led by pulleys to the bedside. As to the sash fastener, there is one almost identical, but superior, in the market, called the "Binder" sash fastener.—B. A. B.

Gold from Gilders' Rags.—A. B. (*Newry*)—First, burn them in a closed vessel—porcelain for choice; but if an iron vessel is used, then it should have a layer of thick paper placed in it for the rags to rest upon. The layer of paper will, even when burnt, help to prevent the metal attaching itself to the iron. If the burning is done carefully there should be no risk of this, for it is quite possible to completely burn the rags to a cinder without making the pan more than red-hot. Secondly, powder the burnt stuff up in a mortar, and mix one quarter of its weight of powdered pearlash with it; put it in a furnace, and run it down. If the flux does not come all of one consistency, a little more pearlash can be added until it does. If it shows signs of boiling over, add a little dry powdered salt. When the boiling mass of flux is regular in its composition (and you can test that by dipping the poker in and removing some on the end), the pot can be taken from the fire, left to cool; and when cool it can be broken, when there will be a button of gold at the bottom. So far I have tried to comply with the inquirer's wishes; but it is for him to consider if it is worth while to carry out this process; otherwise the quantity, if large, might be burnt and powdered, and sent to a refiner for an offer; if small, then they might go with the shop sweep, when that is sent.—H. S. G.

Galvanising Process.—The London Metallurgical Co., Ltd., Turnmill Street, E.C., work the process referred to in WORK, No. 162.—ED.

Regilding Metal Clock.—H. J. G. (*No Address*).—It is not worth considering, this idea of yours, to gild metal-work with gold leaf; it will not look nice, even if you do succeed in sticking the gold-leaf on. If you are in Clerkenwell, or in Soho, you might ask a gilder what his charge would be. Gilding is now done very cheap, and it might cost you but little more than your gold-leaf. If you cannot afford to gild it, why not clean it by well washing in hot soap and water? Soap the brush well that you use, and dust a little carbonate of soda on it; then well rub the article, rinse it well, and dry in warm boxwood sawdust. If the gilding is much tarnished, it can be partly restored by wiping it over quickly with a weak solution of cyanide of potassium, rinsing it quickly and thoroughly, and drying at once in boxwood dust.—H. S. G.

Automatic Expansion Gear.—A. B. (*Sheffield*).—I do not think you will get the information you require unless you apply to the patentee at Leeds. He sends a lithograph of the link gear with every governor supplied, and when desired, marks the cut-off and angular advance upon it. I should think a simple governor of the "Porter" type would be more suitable for your engine.—F. C.

Ship on Musical Box.—FLASHING DYNAMO.—Your sketch shows no means of rocking the ship on the lever H G. This lever should be carried on a short spindle fixed at its bend at the end G; the upper hole, which should be larger than the barrel axle to clear it, should be passed over the latter, and on the inner side of the wheel E a rim of spiral or wedge form should be fixed for the tail end of level, H G, to rest against. As the rising part of the rim passes behind the lever-tail, the rocking motion will be given, and if you desire to have several oscillations of the ship during one revolution of the barrel, you may attain this end by making the rim with a wavy or undulating edge. By carrying the spindle fixed at the bend in rocking bearings and fixing a small eccentric on the barrel shaft, F, to fit the hole in the lever, H G, transversely, you may obtain a rolling motion in addition to the rocking; in this case you must make the hole in the lever long enough vertically for the eccentric to revolve without touching the top or bottom thereof.—F. C.

Dulcimer.—JULES and S. W. (*Glasgow*).—Articles on the construction of a dulcimer appeared in WORK, Nos. 31, 38, and 41.

Canoe Building.—GARBOARD STRAKE.—Articles on "Canoe Building" appeared in WORK, Nos. 53, 58, and 62.

Boiler for ¼ h.-p. Engine.—J. B. (*Essex*).—I could not advise an amateur to attempt to make a boiler unless it were a coil boiler, and not many believe in these or will have anything to do with them; I believe they really answer with those who understand them, and I am promised some information on the coil boilers used on launches in America, Of course, they are very convenient in some ways, such as getting up steam in five or six minutes, and in not being liable to explode. In a list of boilers lying before me, I find the following proportions for ¾ h.-p., which would be amply large enough for the ¼ h.-p. engine: Shell, 3 ft. by 1 ft. 6 in. diameter, ⅛ in. thick; fire-box, 1 ft. 7 in. by 1 ft. 3 in. diameter, ¼ in. thick; crown-plate, $\frac{5}{16}$ in. thick; approximate weight, 3½ cwt. There may be a cross-tube in the furnace, but it will make enough steam without.—F. A. M.

Electric Light.—S. J. (*Brandon Colliery*).—To light up the room you mention in your letter—viz., 15 ft. by 16 ft. by 9 ft.—you would want at least one 20 c.-p. lamp, two 10 c.-p. lamps, or four 5 c.-p. ones. Let us see what this means. To begin with, you will not get any satisfaction out of the E. C. dry cells, as they are not constructed to give steady

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continuous currents. The only ones that would do would be either Bunsen's—which you cannot have in the room—or double carbon, single fluid chromic acid cells. Now, to light up a 20 c.-p. lamp, you will require at least 20 chromic acid cells, and more even if you use Bunsen's, as the least voltage you can light a 20 c.-p. lamp with is 40 volts. Now, if you use large cells and run this battery, say, six hours every evening, the most it would last is three evenings (perhaps not that), and then the whole will want recharging, cleaning, etc. From this you can see that it is impossible to compete even with paraffin lamps when primary batteries are used for small lights. Should you wish simply to rig up a small bracket with the electric light, only to be used on special occasions, this you can do by using 8 volt 5 c.-p. lamps, one of which can be lighted by a battery of four cells of the chromic acid type. Half-pint cells will last you one evening. Let me advise you to get WORK, Vol. II., Nos. 76, 82, and 89. In these numbers you will find more than can be stated in the limited space of "Shop." As to your second question, lamps cost about from 5s. to 6s. 6d. each. It takes just as much trouble to make a 1 c.-p. lamp as a 20 c.-p.—J. B.

Forth Bridge Caisson Work.—P. B. H. (*Southport*).—Your rather curious criticisms upon my article on "Caisson Work" are scarcely worth refuting, but, as you are so obviously wrong, I will mention the facts. The foundations were carried to more than 88 feet. The greatest depth reached, according to Mr. Phillips, C.E., was 90 ft., to which depth the caissons were sunk. Mr. A. Morrison, of Queensferry, says that "the lowest point in the foundations descend to 91 ft. below high water." Mr. Cooper, the engineer of the bridge, said in his paper, read in 1888, on the Forth Bridge: "The extreme depth of the foundations is 91 ft. below the level of high water." I consider that 88 ft. is a good average depth to quote. So much for No. 1. (2) As to Query 2, the height is 209 ft. Mr. Phillips, C.E., says, speaking of the cantilever piers, "The dimensions of the pier are at cutwater about 96 ft. by 45 ft. . . . rising to a total height of 209 ft. above high water." Your "criticism" is not very near this. No. 3 is not worth notice. (4) The caissons were sunk to a depth of from 71 ft. to 89 ft.; the Inchgarvie caissons to 72 ft. (See "Chambers' Cyclopædia," etc.). As regards the term "emitted," I need not dispute: the compressed air was, of course, equalised with the outer air from above. P. B. H. seems to differ from the engineers, and he can consult the authorities named and others.—H. F.

Invalid's Carriage.—NOVICE.—I am afraid there is no way in which you could work an invalid carriage, such as you mention in your letter, for a sick child, by primary batteries. The thing could be done with accumulators, but the cost of charging them, keeping them and the motor in working order, would be more than employing an able-bodied man to wheel the child about every day—to say nothing of the cost in the first instance of a rather complicated machine. If the poor little lad is still pretty lusty in his arms, the best thing you can do is to rig up his little carriage with a crank and lever, giving him all the power you can at the sacrifice of pace. Send a sketch of what you propose, and you shall have all the help that can be given you; but banish from your head all ideas of working such a thing by electricity.—J. B.

Wire-Wove Roofing.—GENEVA CROSS.—The roofing material that you inquire about is made by the New Wire-Wove Roofing Company, 164, Queen Victoria Street, London, E.C. It is a good substitute for glass, being durable, unbreakable, and translucent. The material consists of a fine iron wire netting, woven warp and weft, covered on both sides with a transparent material of the consistency and appearance of the finest glue. Called by the name of "Duroline," this substance is really a permanent varnish, of which linseed oil is the base. The colour is a slight amber or greenish yellow shade that, under exposure to the air, bleaches until it admits a nearly white light. It is soft enough to be cut with a pair of scissors, and yet requires extreme violence to tear it, while it is practically unbreakable. The price runs about 5½d. to 6½d. per square foot, which is slightly in advance of the price of glass, but this is compensated for by its greater durability. It is sold in sheets of various widths, or in cut size to order. As to the wood for the framework of your aviary, pitch-pine or redwood would be very suitable and easily worked, and would stand a long time under fair wear and tear. If you can procure teak easily, it would be better still, but is more expensive and difficult to work, as, being full of sand, it destroys the edges of the tools very rapidly.—G. LE B.

Crystals.—A. R. (*Stourminster Newton*).—Thiosinanine can be obtained from Messrs. Hopkin & Williams, 16, Cross Street, Hatton Garden, E.C.—W.

Overmantel.—J. G. (*Bala*).—I hope the accompanying design is what you require. The cut pieces are of ½ in., and the framing, uprights, and shelves of 1 in. stuff, while the brackets are 1½ in. thick. The bottom shelf can be 7 in. wide, supported on two brackets; with a framed panel between the latter resting on the architrave. The shelf is moulded and rounded at the ends. Above this is a small bevelled mirror resting on a plinth, and on each side a half round shelf, A, supported on wood brackets. You had better cut the hollow on these latter pretty deep, or else they will look heavy. Above this mirror is the pediment

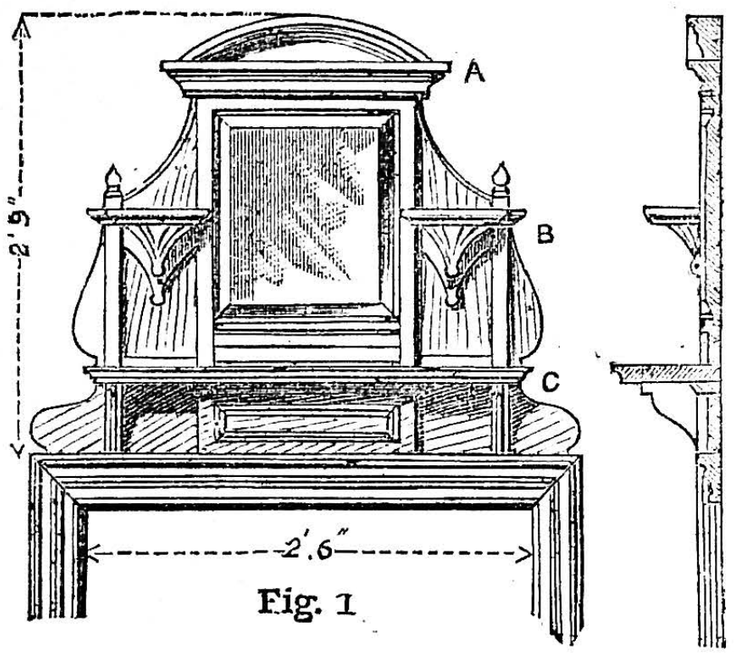

Fig. 1

Fig. 2

Overmantel. Fig. 1.—Elevation of Overmantel. Fig. 2.—Section.

and cornice, which give a good finish to the overmantel. The design would look well if executed in ash, but you will find that wood rather hard to work. The cheaper kinds of overmantels are generally made of deal, and the superior sort of walnut or oak.—F. J.

Window.—SECOND APPLICATION.—I consider that French, or casement windows, are easier for an amateur to make or understand than cased frames with double-hung sashes; so if you have thoroughly digested the articles on "Hung Sashes"

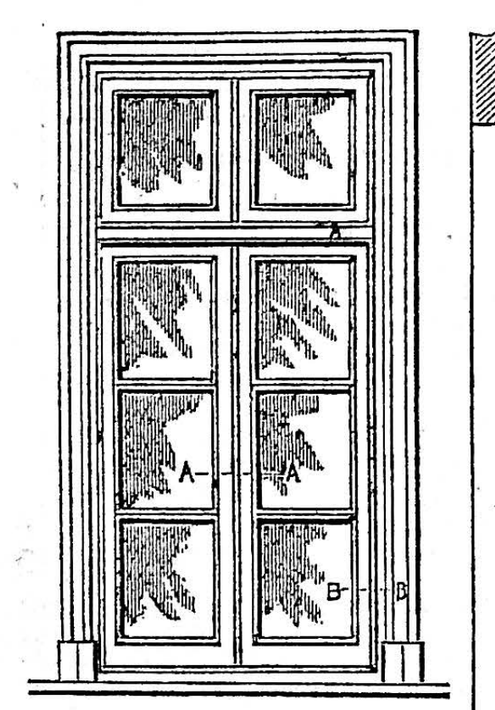

Fig. 1

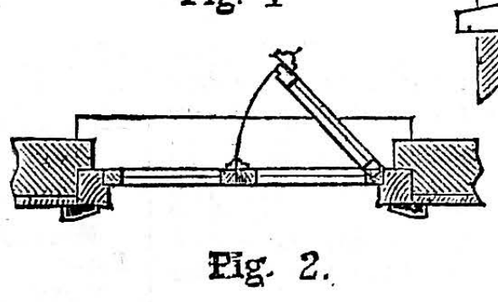

Fig. 2.

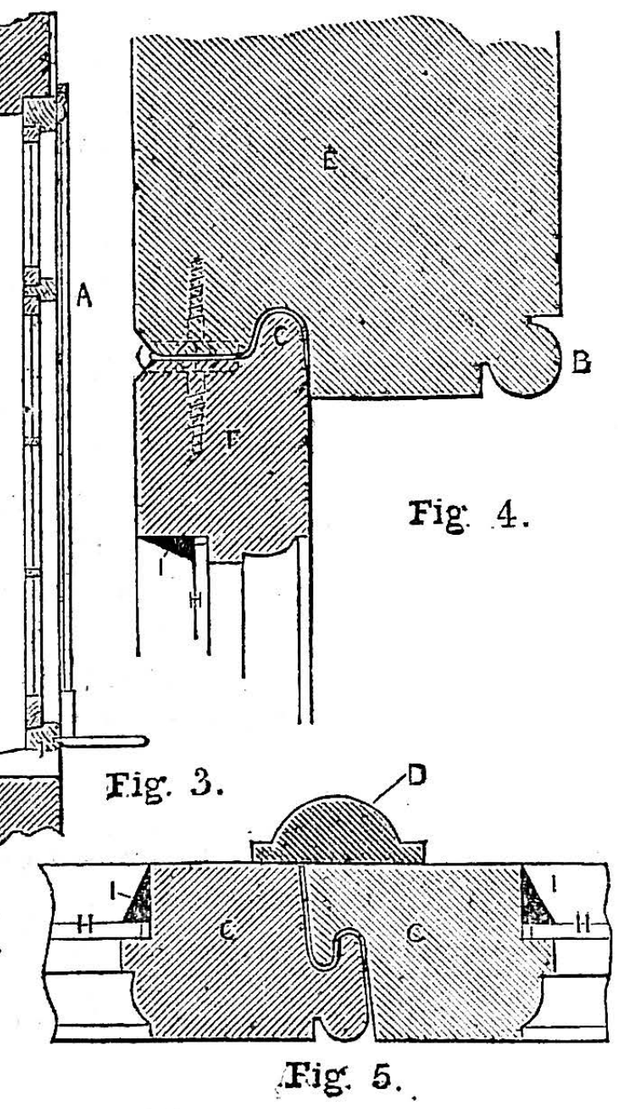

Fig. 3.

Fig. 4.

Fig. 5.

Window. Fig. 1.—Elevation of Inside of Casement Window. Fig. 2.—Horizontal Section. Fig. 3.—Vertical Section. Figs. 4 and 5.—Details of Joints—A, Transom; B, Staff Bead; C, Weathered Joint; D, Fillet; E, Frame; F, Hanging Style of Doors; G, Shutting Style of Doors; H, Glass; Putties.

that have appeared from time to time, you will have no difficulty in following the description of casements given here. The description must of necessity be very brief, on account of the great pressure on the columns of "Shop." Fig. 1 is an inside elevation of a pair of casements and frame, showing the architrave mouldings round the same. The glazed portion above the transom, A, is a separate sash; this is very often necessary, on account of the height of the room, etc., and is generally fixed, but can readily be hung if wanted. Figs. 2 and 3 are horizontal and vertical sections, showing the solid window frame, etc. You ask for thickness of material; but this is always regulated by the position, thickness of walls, etc. The sizes shown on these sections are:—head and sides of frame 4½ in. by 4½ in.; oak sill, 4½ in. by 3½ in.; transom, 4½ in. by 3 in.; sashes, 2 in. thick. The frames of casements are very often made out of 4½ in. by 3 in., and the stops nailed or planted on to form the rebates, but this is very seldom done in good work. The sashes should never be less than 2. in. thick—that is to say, out of 2 in. stuff—and should always be made to open outwards if possible, especially in exposed places, as then the wind pressing upon them from the outside only makes them close more tightly. They should be hung with either brass or wrought-iron butts, never with cast-iron butts, on account of their exposure to the weather. In making the same, the uprights are tenoned into the head and sill, and a return bead is sometimes stuck on the inside edge of the frame, as shown at B (Fig. 4); but this is not absolutely necessary. Sometimes the architrave is brought up quite close to this edge—in fact, there is no limit to the various methods of finishing the inside of solid frames; but this does not concern us; what I am describing is a *plain* casement frame. The frame is very similar to a solid door frame, with the exception that whereas the side edges of a door (that is very often exposed to quite as much weather as a window) are fitted into a square rebate, the side edges of a casement are generally shaped so as to fit into a circular recess made in the frame, as shown at C (Fig. 4). But this does not present any great difficulties; all that is wanted is a plough rebate plane, and a hollow and round plane to fit the circle required. Very often the plough iron is rounded to make the groove, but unless this joint is made very nicely it is very little better than the plain rebate. There are several other methods adopted for keeping the weather out, but the limited space at my command will not allow of my explaining them. Fig. 5 shows the joint between the two doors, known as a "hook joint"; there are special planes made for doing this, but unless there are a lot to do it is not worth while buying them, as it can readily be done with a rounded plough iron or hollows and rounds. Before bevelling the edges, try the sweep the doors will make in opening, by taking the width of one door as radius and describing an arc (Fig. 2); this will give the exact bevel, and by allowing a little, you can feel sure the door will unlock at the joint without wanting easing, and so spoil the joint after it is made. D (Fig. 5) is a fillet nailed on to the outside of the sash that opens first, to further protect the joint. From your letter, I take it that you only want one leaf or door to open; if this is so, I think I should dispense with the joint if it presents any difficulty in making, and depend on a good rebated joint protected with a fillet outside. The making of the casements are so similar to ordinary sashes that it is hardly worth while to describe them. It is very necessary to have a good fastening to casement windows to hold them tightly in their place. The best method is known as an "Espagnolette bolt"; it consists of a rod connecting a bolt on top and bottom of the door, and so arranged that a turn of the handle shuts both bolts simultaneously, and also secures both sashes together in the centre. If this description is not all that you require, write again, and I will put you right on any little matter you do not understand.—E. D.

Removing Paint.—A. W. (*Glasgow*).—You will find the following recipe answer your purpose as well as anything you can try:—Take 1 lb. American pearlash and 3 lbs. quick stone lime; slack the lime in water, then add the pearlash, and make the whole about the consistence of paint. Cover well with the mixture, applying it with a sash-tool, and let it remain several hours. If necessary, give it a second coat.—W. E. D., JR.

China Drilling.—READER OF "WORK."—As the writer of the article in question, I am very pleased to know it has been of use to you. I do not know any place where you can buy half-round brass wire ready for using; but surely the trouble of making it ready for your purpose is not much. You can prepare sufficient wire for two or three dozen in about two minutes. A small coil of round brass wire can be bought at any ironmonger's. Take a length about two feet, and holding an old knife, as mentioned in the article, draw the wire against it two or three times, and it is done. If you have not tried to make it, do so; I am sure you will succeed, it is so simple; but if you would rather buy, if you will write me through the Editor, I would procure you what you want. I do not know of any manufacturers who would issue a book or pamphlet on moulding glass; it would hardly pay them to describe their own method for the benefit of other makers. For moulded articles of glass, apply to Messrs. J. Powell & Sons, Whitefriars Glass Works, Temple Street, London. Do you wish to buy the splints retail or wholesale? Write either to the address given in the article or to Messrs. Woods & Toussaint,

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54, Spencer Street, Clerkenwell, London, E.C.—W. E. D., JR.

Property in Chancery.—F. H. (*Bermondsey, S.E.*).—You had better advertise your assistance in our "Sale and Exchange" Column.

Model Boat Building.—J. E. (*Deptford*).—This is receiving much attention in WORK. See Nos. 160 to 166 and subsequent ones.

Model Making.—W. H. D. (*Liverpool*).—Papers are constantly appearing in WORK.

Cast Steel Name, etc., Marks for Iron and Steel.—B. R. P. (*Battersea*).—The steel stamps referred to in your letter of inquiry are charged for according to the number and size of letters, thus :—

Letters.		Letters (27 to the Set).			
Under $\frac{1}{16}$ in.,	2d. per letter.	$\frac{1}{16}$ and $\frac{3}{32}$ in.,		6s.	per set.
$\frac{1}{16}$ in.	1½d. „	$\frac{1}{8}$ in.	...	7s.	„
$\frac{1}{8}$ in.	2d. „	$\frac{5}{32}$ in.	...	8s.	„
$\frac{5}{32}$ in.	2½d. „	$\frac{3}{16}$ in.	...	10s. 6d.	„
$\frac{3}{16}$ in.	3d. „	$\frac{1}{4}$ in.	...	14s. 6d.	„
$\frac{1}{4}$ in.	4d. „	$\frac{5}{16}$ in.	...	17s.	„
$\frac{5}{16}$ in.	5d. „	$\frac{3}{8}$ in.	...	21s.	„
$\frac{3}{8}$ in.	6d. „	$\frac{1}{2}$ in.	...	28s.	„
$\frac{1}{2}$ in.	8d. „	Value of steel included.			

Steel and forgings extra.

Figures (9 to the set).

$\frac{1}{16}$ and $\frac{3}{32}$ in.	per set	...	...	2s. 6d.
$\frac{1}{8}$ in.	„	...	...	3s.
$\frac{5}{32}$ in.	„	...	...	3s. 6d.
$\frac{3}{16}$ in.	„	...	...	4s.
$\frac{1}{4}$ in.	„	...	...	5s. 6d.
$\frac{5}{16}$ in.	„	...	...	7s.
$\frac{3}{8}$ In.	„	...	...	8s. 6d.
$\frac{1}{2}$ in.	„	...	...	11s.

Value of steel included.

NOTE.—The second and third price lists are of marks of "extra best quality," and are suitable for engineers and other heavy trades.—N. M.

Marking-Out for Twisted Candlestick.—MERTHYR.—There are several ways, but a very simple way is by winding string round the wood. In a candlestick before me of corkscrew twist, there are two threads, and the twist becomes rather steeper as it rises, which looks well; the pitch is 3 in. If I wanted to mark for this, I would take an elastic ring and stretch it over the bottom part, where the diameter is largest, and slip two threads under the ring on each side, setting them about $\frac{5}{8}$ in. apart, and on opposite sides of the wood; then have another elastic ring 3 in. higher up, and a third 6 in. Now you have only to wind the threads round so that they make one complete turn between each ring. You can move the threads about under the rings till you see the twists are regular and about the right thickness to be strong enough. In mine the candlestick is 10 in. high, and the cross section of the twist is $\frac{1}{2}$ in. at the bottom and $\frac{7}{16}$ in. at the top. All that is easy to arrange by moving the threads under the bands. Now, when all looks right, take a pencil and draw a line under each thread. If you want 4 threads in the twist then you would use 8 threads; that is all. This is much easier than setting out the threads geometrically by measurement.—F. A. M.

Telegraph Instrument.—J. E. (*Braestairie*).—Your letter gives no particulars of what you wish to know.

Photographic Lenses.—AMATEUR.—Consult the advertisement pages of WORK.

Modelling.—G. C. S. (*Inverness Gardens*).—My advice to anyone desirous of taking lessons in modelling, etc., would be that he should join the classes of the nearest Government School of Art at which modelling is professedly taught. Particulars of times and hours can be had at the respective schools. This will be found not only much more economical, but in almost every respect far better than taking private lessons.—M. M.

Water-Wheel.—DYNAMO writes:—"Would any reader kindly inform me what power—*i.e.*, h.-p.—I could get from a 3 ft. by 1½ ft. undershot water-wheel placed over stream running at the rate of about three miles an hour? Also, what diameter of wheel would be required at other end of shaft of water-wheel to drive a 20 c.-p. Manchester dynamo, having a driving pulley 1½ in. in diameter, at the rate of 2,260 revolutions per minute?"

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Tin.—CHEMICUS writes, in answer to YOUNG READER (see No. 168, page 190):—"I make scoops for ordinary shop use out of *empty* condensed milk, cocoa, and other tins. This is done by cutting the tin *diagonally* with an ordinary pair of strong scissors along the dotted line, thus :—

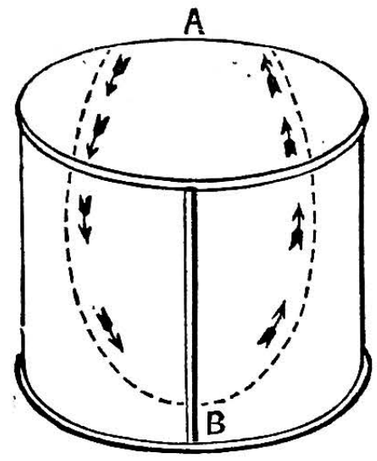


Fig. 1

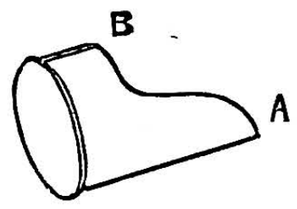
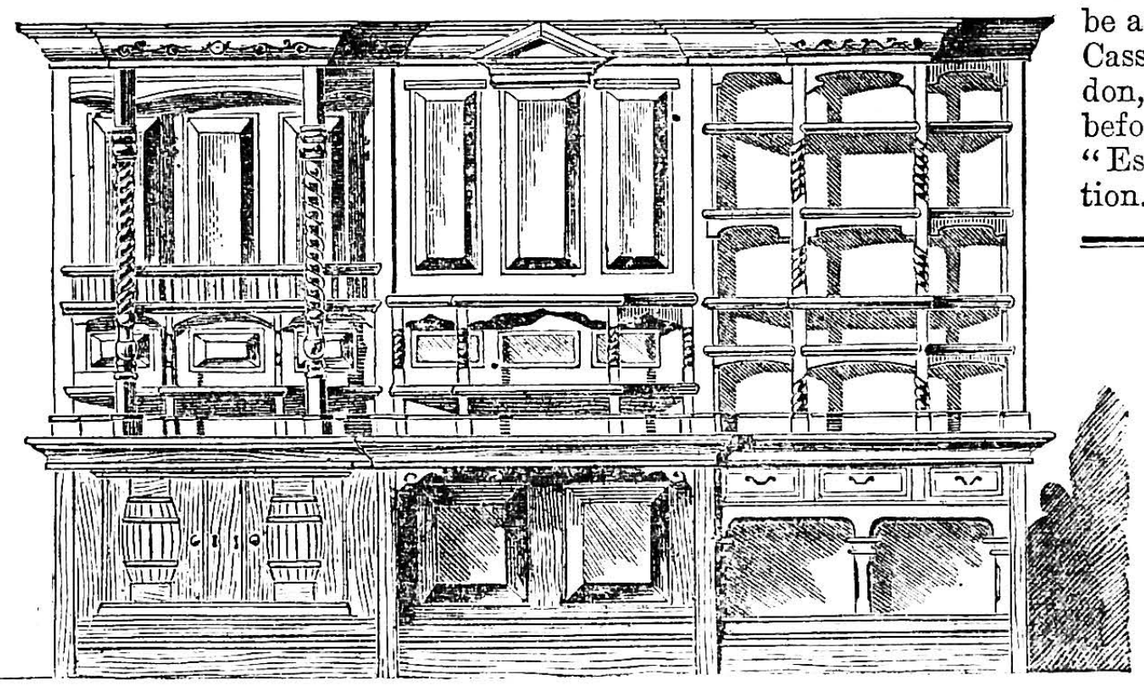


Fig. 2

Fig. 1.—Mode of Cutting. Fig. 2.—Scoop.

Begin to cut at A in the direction of the arrows, as shown, finishing off at the point from which you began. Be careful to keep the seam of the tin where there will be least of it in the scoop, as at B. I have saved many a shilling in this way, besides always having a good supply of scoops in drawers, etc."

Stained Glass Designs.—M. (*Bishop Auckland*) writes to J. B. (*Moss Side*) (see No. 172, p. 254):—"You may get designs from one of the following books: 'Divers Works of Early Masters in Ecclesiastical Decoration,' £3 10s., by Owen Jones; 'A Book of Ornamental Glazing Quarries,' by A. W. Franks, £1 1s.; 'Westlake's History of Stained Glass,' Vol. I.—Fourteenth Century, 13s. 6d.; Vol. III.—Fifteenth Century, 18s., published by Batsford, 52, High Holborn."



Refreshment Room Sideboard.

III.—QUESTIONS SUBMITTED TO READERS.

*** *The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Stirrups.—LONDON SADDLER writes:—"This is a subject of much importance, and I shall be glad to hear brother readers' views and experiences with stirrups of old pattern or patents."

Concertina.—YOUTHFUL READER writes:—"Will some kind reader give me a few hints as to making a concertina?"

Coins and Medals.—NUMIS writes:—"It would be a great help to me if some reader of WORK could suggest some ideas for mounting them."

Birdlime.—A YOUNG READER writes:—"I shall feel obliged to be informed as to the way in which birdlime is made from the elder-tree."

Joiners' Work.—REG writes:—"Can any brother reader recommend a good practical book respecting joiners' work for inside of churches, chapels, etc.—that is, pulpits, seats, etc. etc.?"

Horse-hair Weaving.—J. W. (*Dundee*) will thank any brother reader to give him some information as to the weaving of horse-hair as used for coverings of chairs and sofas.

Aphengoscope.—F. C. K. (*Mapleton*) writes:—"Will some reader kindly give me instructions, with diagrams and measurements, how to make an aphengoscope, suitable for use with a pair of Hughes's large pamphengos lanterns, with 4-wick lamps?"

Refreshment Room Sideboard.—F. J. (*Exeter*) writes, in answer to A. D. B. (*South Shields*) (see No. 171, page 238):—"Perhaps this design is the kind of thing you require. The drawing shows an alternative for one of the wings. The sketch is to ¼ in. scale. It is impossible to tell you what the cost would be; it all depends upon the kind of work you put in it; bevelled mirrors and expensive mouldings and ornament will double or treble the cost of a plain article."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—R. B. T. (*Tyldesley*); F. A. W. (*Bracesley*); DOG; PRECISE; H. C. (*Norwich*); ANXIOUS; H. T. (*St. Helens*); C. W. S. (*London, S.E.*); W. W. W. (*Wembley*); CONSTANT READER OF "WORK"; O. K. (*No Address*); W. J. H. (*Govan*); J. M. H. (*Glasgow*); H. W. (*Byfield*); G. H. (*Ashford*); PHŒNIX; E. C. J. (*Kyneaton, Victoria*); A. H. S. (*Kelvinside*); R. B. (*Galashiels*); A. B. D. (*South Shields*); C. O. (*Albany, West Australia*); R. D. T. (*Marylebone Road*); J. H. W. (*Halifax*); F. P. (*Camden Hill*); O. B. & CO. (*London*); F. McG. (*Dublin*); DESIDERATUM; P. E. (*Birkenhead*); ANXIOUS ONE; H. C. B. (*Ascot*); WORKMAN; MUSIC; H. B. (*Worcester*); C. R. & CO. (*Darlaston*); S. H. S. (*Barnsbury*); A. W. (*Stockport*); J. T. L. (*Ho Grace, Newfoundland*); NOVICE ELECTRO; F. J. K. (*Tufnell Park*); C. A. I. (*Manchester*); J. W. (*Askham-in-Furness*); J. T. (*Glasgow*); M. & C., LIMITED (*Ardwick*); F. R. H. (*Stoke Newington*); SHAVER; WOULD-BE DRIVER; H. J. C. (*Hampstead*); CARVER (*Bristol*); A POOR MAN; TWO YEARS' SUBSCRIBER; J. B. (*Fulbourn*); C. L. M. (*Glasgow*); A LOVER OF "WORK"; F. B. (*Oldham*); THEORY; R. M. C. (*Gravesend*); MODEL.

"WORK" PRIZE SCHEME.

THIRD COMPETITION.

Escape from Fire Device.

FOR the three best suggestions for an appliance, plan, or practical idea for Escape from Fire, the following prizes will be awarded—

First Prize, £3;
Second Prize, £2;
Third Prize, £1.

CONDITIONS AND RULES OF THE "ESCAPE FROM FIRE DEVICE" COMPETITION.

ALL Descriptions to bear the WORK Prize Coupon, cut from one of the numbers of WORK in which the Prize Scheme is announced.

Each Description to be signed with an original *nom de plume*, and to have the writer's real name and address securely attached to the manuscript in a sealed envelope.

Each Suggestion should be fully described in respect to its construction, conditional surroundings, and working, and, where possible, should be illustrated with a drawing of the device itself and its various parts to elucidate the description.

A Suggestion not illustrated will have an equal claim in the competition provided the description be sufficiently in detail to convey a full idea of the value of the device.

The Prize Devices and Drawings, and any others, to be published, if desired by the Editor, in WORK, but the copyright thereof to remain with the authors.

Copies of MSS. and Drawings to be retained by the competitors, as in no case can the return of MSS. be undertaken.

The Editor of WORK will supervise the judging of the Suggestions, and the selection as determined upon is to be final.

All manuscripts intended for the "Escape from Fire Device" Competition must be addressed to the Editor of WORK, c/o Cassell & Co., Ltd., Ludgate Hill, London, E.C. They must reach him on or before SATURDAY, AUGUST 27, endorsed, "Escape from Fire Device" Competition.

NOTICE TO READERS.

AMONG the contents of next issue (No. 180) will be:—A SMALL TABLE IN ENAMEL; MAKESHIFT COMBINATION WORK-BENCH; WATCH AND CLOCK CLEANING AND REPAIRING; CHEMICAL APPARATUS MAKING.

*** The Editor makes this intimation in the hope that readers, having friends interested in any of these subjects, will bring the same to their notice.

SALE AND EXCHANGE.

Victor Supply Co., Grimsby, sell Mail-cart Wheels and Parts. [5 R

Caplatzi's Cheap Technical Collections embrace most things electrical, optical, mechanical, chemical, photographic, models, materials. Catalogues, 2d.—Chenies Street, Bedford Square. [4 R

Lettering and Sign-Writing made Easy.—Also full-size diagrams for marking out eight alphabets, only 1s.—F. COULTHARD, Darlington Street, Bath. Note.—100 Decorators' Stencils (60 large sheets), 2s. 6d.

100 Fretwork Designs (new), 100 Carving, 100 Repoussé, 30 Fret Brackets, 100 Sign Writers' Stencils (all full size), 300 Turning, 400 Small Stencils. Each packet, 1s.; postage free.—F. COULTHARD, Darlington Street, Bath. [1 S

Chip Carving.—New registered tools, one-fourth the labour. 12 sheets chip-carving designs; 12 wood-carving do.; 12 fret-cutting do.; 1s. per set. List of tools on application.—BUCKLEY, Teacher of Wood Carving, Mirfield, Yorks. [11 R

Electrical Apparatus, Castings and Parts for Amateurs, etc. Lists, one stamp.—ATKINSON, Holly Road, Handsworth, Birmingham. [12 R

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